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A study of the use and experience of touch in artistic, multimodal and computer-based environments

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Virtual Touch

**- A study of the use and experience of touch
in artistic, multimodal and computer-based
environments**

Ståle Stenslie

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Abstract

The central focus of this thesis is the use and experience of touch in artistic, multimodal and computer-based environments. The haptic experience of touch is an area that has only received limited research-based interest. Touch is too often seen as the effect, and not the cause of our everyday experiences. The study aims to provide an improved knowledge of how touch functions and how haptic storytelling can be used as an artistic medium.

This thesis is divided into seven parts. The introductory chapter presents the structure of the study and the history leading up the formulation of research questions and hypotheses. Further it contextualizes the research in a broader context. The second chapter presents my bricolage of methodological choices and puts them in relation to art, technology and aesthetics. Here the thesis is presented as practice-based research focused on my artistic experiment Erotogod. The third chapter investigates the foundations of touch through a physiological and psychological approach. Chapter four presents an alternative haptic history of Virtual Realities through the presentation and discussion of several technological and artistic works that are computer-based. In chapter five touch is approached from a theoretical point of view. It develops a theory of touch based on phenomenology and shows how this approach advances an embodied thinking. Chapter six presents practice-based experiments of touch through the Erotogod installation. The last and seventh part is the analysis and conclusion of my experiments.

The problems addressed concern how it feels to touch and be touched in multimodal environments, or so called Virtual Realities. Firstly how haptic, corporeal interaction influence the overall experience of a given interactive human-to-computer system. Secondly it addresses the role of vibrotactile stimulation within multimodal, computer-enabled environments. Another problem addressed is examining the way touch can be used to construct meaningful haptic content and experiences in the context of art.

The method of solving the problems has been developed through practice-based research in the arts. The thesis examines and assesses the scope of the research appropriate to art practice. This is done primarily through the investigation and assessment of practical art experiments as a working

method. Specifically the bodysuit of the practice-based experiment Erotogod functions as a two-way tactile display, conveying vibrotactile feedback to the body and interfacing the human to the computer through touch. Erotogod portrays how touch appears in works of art, and how it affects the artworks.

Theoretically touch is investigated through a phenomenological approach on the way the world of our experience is constituted for us. This experimental approach centres on the phenomenon of perceptual breakdown and how this reveals dimensions of touch. A phenomenology of touch as it appears here, allows us to understand the interplay between subjective, felt embodiment and the psychophysically-contextualized work of art

The main results and applications of the study are firstly that haptic technologies bridge the gap between the real (corporeal) and the virtual (immaterial) world, supporting the assumption that the distinction between the ‘virtual’ and the ‘real’ is not convincing in itself. Haptic stimuli in general and vibrotactile stimuli in particular, can have the effect of making the virtual appear more real. Another result is showing how haptic experiences add to the user’s qualitative experience of a multimodal art installation. Technologically the thesis shows how higher sensory resolution adds to the sense of being immersed in a physically ‘real’ virtual world. Important for future studies is the way my research indicates new possibilities of haptic expressions that can form general expressions to be used in future forms of haptic storytelling. Further the thesis presents a long-term documentation and development of touch-based interactions.

New in this thesis and approach are the combinations of various theories of touch, and in particular its application to works of art where touch appears as a genuine artistic medium. It also contributes to the definition of new practices of inquiry and knowledge-making.

Conclusions: This thesis contributes substantially to knowledge-generation about the multimodality of touch within the art field. I hope that it also opens up unexplored avenues of research - how we perceive and produce art.

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Ståle Stenslie, Oslo, June 2010.

Preface: Confessions of a media artist

The focus of this thesis is on the experience of touch mediated through technology. My research is positioned within the field and context of art. Further, my artistic research is situated within the tradition of experimental media art. Whereas the roots of experimentations with media and perception go a long way back (Zielinski, 2006 and Grau, 2003), this is an emerging field of research that in its digital form started in the 1960s and became a cultural mass phenomenon with the personal computer.

In finding methods that are applicable and useful as knowledge-building tools in the field of art, I recognize the strong qualitative approach of my research. My findings are based on my own experiences and projects.

The fact that my own work on touch is at the centre of this thesis implies a lack of distance between the experience (subject) and the object (observed) of inquiry. However, this topic is of personal interest for me, and in line with the openness of my chosen way of doing artistic research I hope that the knowledge developed through personal engagement outweighs the lack of distance. I have firsthand experience with the topic that enables me to write, reflect upon and represent cases of field work in a unique way. I have found great inspiration in the method of confessional writing (Denzin and Lincoln, 2000:733). With this I practice writing in a first-person style where the author tries his utmost to describe the circumstances and finding of his research in a subjective manner. It is my intention as well as hope that the partially subjective descriptions in this work will expose my own and personal epistemological path of building new knowledge within the arts.

Parts of the text in this book have previously been published as articles in the AHO's Research magazine no. 5 (Stenslie, 2002), the CAIA proceedings (Stenslie, 2003), The Senses & Society magazine (Stenslie, 2009), for the 'Touch Me' festival in Zagreb 2008 (Stenslie, 2008)¹ and the Nordes conference in 2009 (Stenslie, 2009).²

¹ <http://www.kontejner.org/haptic-hedonism-english> accessed on March 27th 2010.

² <http://ocs.sfu.ca/nordes/index.php/nordes/2009/paper/view/203/154> accessed on March 27th 2010.

1. BEING VIRTUALLY TOUCHED

1.1 INTRODUCTION

Your Body is Your Battleground. - Barbara Kruger

This thesis is a study of how physical touch is experienced in the context of virtual, computer and media art based environments. The experience of touch is investigated within artistic contexts and in combination with real, measurable physical stimulations.

The key issue throughout the thesis is the question *how does it feel to touch and be touched in virtual realities?* It is a seemingly innocent and simple question, but it is not an easy one to answer. After all, what does it mean to feel? How do feelings arise? How do we deal with them? How can they be manipulated? What are the physical versus mental components of feelings? How are they produced? Can they be duplicated? Stored? Recalled? What ‘meanings’ can be formed using touch? How does touch affect perception when it comes to art? Can touch possibly change the way we produce and experience art? Is touch a genuine artistic medium?

These are some of the core issues of this thesis. I have come to ask these questions through my work with and reflection on touching technologies since 1992. Over time I have come to recognize that touch is no simple matter, but a complex field of knowledge that often – as Kruger notes above – turns the body into a battleground for various factors ranging from cultural codes, moral and religious beliefs to the medical and practical ones involved in our fundamental need to survive everyday life. Also, the body appears as a temporal and fleeting structure that is hard to grasp. As Jean-Luc Nancy formulates it; *‘Body is certitude shattered and blown to bits’* (2008:5). Conceivably the body in general, and touch in particular, can therefore never be fully understood. Nonetheless it presents an intriguing challenge to grapple with this everyday structure and our ‘general medium for having a world’ (Merleau-Ponty, 2003:169).

Within the limits of a thesis it is not possible to thoroughly cover all the topics raised here at the outset. To get a better view of the outcome and relevance of this thesis, the following are the most important keypoints framing this research:

- My artistic research is positioned within the field and context of art in general, and experimental media art in particular.
- It investigates how virtual touch appears in works of art, and how it affects the artwork.
- Virtual touch (VT) stands for the experience of touch mediated through electronic and digital technology.
- The field of haptic technologies relates to the sense of touch in all its forms (see section 1.6) and will be looked into with the intention of seeing how touch can be used to construct meaningful haptic content and experiences.
- The thesis attempts to explore how a more precise vocabulary of touch can serve haptic storytelling, that is create meaningful experiences and expressions through the use of touch as an artistic material.

Technically this research will look into how to apply and use physical touch with and through digital technologies. These will also demonstrate how the body's perceptual apparatus can be influenced and even to some extent controlled by neural stimulation. My primary point of interest in touch is skin contact as direct physio-corporeal experience. But touch concerns much more than the physical. It stands in relation to visual as well as indirect (non-corporeal) ways of inducing the sensations of being touched.

Virtual touch specifically concerns how physical touch is perceived in the context of virtual, computer and media art-based environments. Within this field, experience is a matter of combining real, measurable physical stimulation with the mental perception of it. In short, this is a matter of psychophysical induction technologies (see section 3.3.6). Our experience is a result of a complex chain of connected events. Its meaning is defined by what Merleau-Ponty calls the *intentional arc*: *'which projects around about us our past, our future, our human setting, our physical, ideological and moral situation'* (Merleau-Ponty, 2003:157).

It is no easy task to chart out the genealogy of touch, and it is not the intention to do so within the limits of this thesis. Rather, its intention is to provide a first cartography that map out specific parts of the use and perception of touch.

The main epistemological aim of this research is to develop a conceptual framework for understanding haptic stimuli and communication. My *specific*

aim is to develop an approach to touch as a tool applicable to body-based haptic systems and in particular through the use of *bodysuits*. These are tactile displays (Pasquero, 2006:2) that convey artificial tactile feedback to the body and – as in my works with two way bodysuits – transmit the human touch back into the computer. Another aim is to develop a vocabulary of touch that can be used to tell haptic stories across disciplines and artistic expressions. This, however, is a long term goal that is beyond what is practically possible in the context of this thesis. To prepare the ground, I will endeavor to contribute to the establishment of an interdisciplinary discourse on how touch affects multimodal, interactive media works by:

- Investigating how haptic stimuli influence the experience of multimodal, computer-constructed environments.
- Identifying dimensions of haptic experience.
- Investigating haptic input and output that affects the experience of interactivity.
- Investigating how human emotions and reactions can be measured in relation to touch
- Understanding and model users' emotional experiences.

To reach these goals, research activities are needed that analyze theoretical and empirical studies of interactive and touch-based media art to see what effects haptics has on the user experience. In my research I will:

- Examine and assess the scope of the research appropriate to art practice.
- Investigate and assess practical art experiments as a working method.
- Development of experimental art practice.
- Examine interface development through practice.
- Collect and assess output from the research projects.

One motivation to focus on media and art in this thesis is that their amalgamation opens up new ways of exploration. Media art provides a field open to experimentation. In the context of this thesis it has been a good setting to experiment with, as well as experience direct physical sensations through various interface designs. Through festivals like Ars Electronica and international conferences like ISEA and SIGGRAPH, the media arts field has an established tradition of exhibiting highly experimental projects (section 1.10).

As will be further discussed in chapter six, one of my contributions to the field is the making of artistic and haptic frameworks that correlate mental

excitations and apprehensions to the actual physical experience. Michael Heim calls cyberspace a '*metaphysical laboratory, a tool for examining our very sense of reality*' (Heim, 1994:83). Is it also so that the physical body ends where immaterial cyberspace begins? Haptic *technologies* add a physical impression to the mainly visual experience of the three dimensional virtual realities (VR). The visual and simulated reality can be felt outside the monitor. Haptic *stimulations* provide a reality check for virtual worlds and extend the physical world into a corporeal, and therefore physically realized cyberspace. What you do inside VR can have effects in real, corporeal life - and the other way around. As it can be experienced in my artistic projects, haptic impressions in real life can bring life and reality into our psychological perception of such 'artificial' VR worlds. Thereby haptic technologies bridge what is commonly thought of as the gap between the real (corporeal) and the virtual (immaterial) world, supporting the assumption that the distinction between the 'virtual' and the 'real' is not convincing in itself.

This thesis is motivated by the open experimental approaches so often encountered in media art. So far, there exists little and only fragmented research on the use of touch in art and aesthetics. My artistic practice is situated between the traditional fine arts and the experimental, computer-based arts. This gives me an interesting point of departure for this *research through practice* (Frayling, 1993; Hannula in Balkema & Slager, 2004).³ In line with this my artistic research is framed at the crossover between traditional fine art and the new technological possibilities associated with media art. My position as enquirer is in the context of visual arts. My formal training and years of artistic practice is also rooted here. But the issues pertaining to the body are not limited to aesthetics alone. It is therefore the hope of this thesis that it might be relevant to research in related aesthetic fields such as architecture and design.

1.2. STRUCTURE OF THE STUDY

In accordance with the *research through practice* approach, this study is primarily built around my experience with constructing and using interactive media-art installations.

The *present* chapter explains how this exploration of touch came about and how it developed from open ended art works into a research project.

Chapter two displays the methodology behind the research. It also comments on the challenge of how to do artistic research. Combining free artistic expression with formal research could appear as a contradiction in terms, but in practice it is more about finding out how new stories and amalgamations can widen our epistemological horizon. The chapter looks for

³ Research through practice is derived from Fraylings 'research through design' concept (1993).

the relation between art and research and investigates critically what kind of knowledge artistic research generates.

Chapter three describes and discusses how touch functions as a complex, interrelated chain of events involving physiology and psychology against a phenomenological and cultural background.

Chapter four gives an overview of the media-art field with regard to the history of research into touch and touching technologies. Further it describes and discusses my earlier projects as both a chronological and historical developmental process leading towards the *Erotogod* experiment, which is investigated in detail in chapter six.

Chapter five presents a theoretical framework of how bodily experience can be understood in the context of the interactive art experience. The constructive contribution of phenomenology, which involves more than simply describing relations between experience and processes, is thematized here. Phenomenology understands intentionality as a form of being-in-the-world, and recognizes the importance of embodied action for shaping perception. This understanding of the body's fundamental importance makes the body highly relevant for analyzing existential media-art experiences.

Chapter six describes and analyzes in detail my main artistic experiment, the *Erotogod* project from 2001 to 2003. As a method for analysis, I will apply the findings from the preceding theory chapter as well as results from participants' observation and interviews in chapter seven. This chapter also explains to some detail the technical setup and the possibility of developing a haptic language to develop methods for haptic storytelling.

Chapter seven discusses results of the analyses and summarizes reflections and outcomes. Particular weight is here set on the results of the questionnaires and the interpretation/analysis of the users' experience.

Chapter eight sums up my findings and conclusions and points towards future work. Further it gives some recommendations in the areas of media art, touch phenomenology and haptic experience.

1.3. OBSERVATIONS, RESEARCH QUESTIONS AND HYPOTHESIS BUILDING

Within the framework of traditional scientific practice, a scientific hypothesis is an objective statement about the natural world. A hypothesis is an explanation for a phenomenon that can be tested in some way (Kaiser, 2000:66). It also indicates the direction for the research to proceed, and if we've reached our aim. The outcome is independent of whether we accept it, refute it or find it inconclusive. As I work from within the framework of artistic practice, I come from a field that is more about creating and telling narratives than explaining facts. I have spent much time reflecting on how I can produce new, intersubjectively understandable knowledge with one foot

rooted in art and the other in science. My experience indicates that this is possible. However fictional and unrealistic a personal work of art might be, it can – provided it is convincingly good - affect other's perceptions of the world. Thus works of art can possibly be of intersubjective value. When that is the case, it can be both observed and described. In terms of artistic research, we might even see a research methodology characterized by visual elements and visual thinking (Gray, 2004:2). And, as Dourish posits, if embodied interaction can replace the screen (Dourish, 2004:102 and Hauser, 2008:64) a future research methodology could be grounded in embodied interaction. This is a possible scenario as well as a challenge posed by emerging artistic research. From a theory of science point of view it is also comparable with Kuhn's view of how scientific revolutions are generated.

According to Kuhn's notion of shifting paradigms (Kuhn, 1970 and Skirbekk, 2001:433), scientific development does not emerge from the mere collection and accumulation of facts or knowledge, but evolves from a set of changing intellectual circumstances and possibilities. Also in the arts one finds such developments through the telling of new 'stories'. This means that the arts have no fixed disciplinary narrative concerning their theories and methods, but rather draw on various approaches in order to argue for their – often self referential - development. Some researchers go through what Kuhn termed 'Gestalt-switch'; the change from believing in one paradigm to accepting another. This switch is not necessarily 'neutral' or 'logical' (Kaiser, 2000:102), but more often than not, according to Kuhn, new paradigms are developed by young researchers. One of Kuhn's aims was to understand how the hard sciences function, but there is a definite inclination in the arts to look for new trends and the better art (stories) in the young avant-garde. In the words of Dudek, art cannot be significant unless it is new (Runco, 1999:104).

As most artistic practice, hard science is also about creating, telling stories and sharing them with an audience. The dramatic story of how James Watson discovered the double helix and the structure of DNA can also be seen as a story of how scientific practice at its core always will contain deeply subjective issues and motivations (Kaiser, 2000:68).

One significant difference between the two fields is that within the field of art the stories told are much more subjective than within science where the criteria is to be objective in an intersubjective manner. However, one could argue that this is only a qualitative difference, and, as the story of the discovery of Watson and the double helix shows, not a categorical absolute. The better story is perhaps the one that is more compelling, seductive, easy to understand or simply memorable. Perhaps, as with Watson's story, it includes a hint of drama and subjective greed. A qualitative perspective on scientific inquiry in combination with a broad-based inquiry into touch, has in this

thesis led to the formulation of several *open* research questions. These have in turn led to the formulation of both *weak*, that is suggestive and more easily affirmed, as well as *strong*, that is asserting, hypothesis.

The understanding of qualitative science will be further treated in the chapter two on methodology. In this thesis my observations of user experience in my own projects made me realize that I had encountered wicked questions (see also section 1.5.2). A wicked question is a problem that is not discovered before the answer is found. Originally proposed by the designer Horst Rittel (Rittel, 1973), wicked problems are usually problems dependent on the social context where *you don't understand the problem until you have developed a solution* (Conklin, 2006:15).

The wickedness is in my cases –amongst others- represented through the fact that users seemed more engaged and enthusiastic once they were inside the haptic, full-body armor system design. Was this a response to form or functionality? Was the positive reactions caused by the spectacular looks of the installation? Did it seduce the audience into anticipating something so different they had to try it? Had the system design touched a tacit, unarticulated need in the users? Whatever the answers might be, my installations' design triggered a user behavior I had not before observed. It therefore appeared to me that I had stumbled across a better functioning system design and visual appearance than other and comparable immersive installations. Thus, having a (haptic) answer before a problem, two overarching research questions seemed appropriate to start with:

- i: The general question: How does haptic, corporeal interaction influence the overall experience of a given interactive human-to-computer system? and correspondingly,
- ii: The specific question: What is the role of vibrotactile stimulation within multimodal, computer enabled environments?

The term multimodal environment is here referring to installations that use combinations of multiple sensory impressions. Examples are various combinations of sound, still- and moving images, touch, heat, smell, wind and others. Audio-visual (AV) combinations are multimodal, but so commonplace that the multimodal environments of interest here lies in other combinations like sound and touch, image and touch or expanded multimodal combinations of, for example, sound, image and touch. It is this latter combination that this thesis will focus on.

The research question above is asking how the framing of the body - within the borders of technologically driven environments - affects the user experience. This is a question of both perception and haptic mediation related

to the formation of the interface, where the body is included as a part of a technological interface. How this affects experiences is a pressing issue in daily life considering the increasing use of wearable, interactive everyday technologies such as mobile phones, non-local media and technologies as wireless networks (Aarts, 2003:158). While, for example, location-based services for mobile applications make individually-oriented and embodied experiences more important, the opposite happens to former desktop-based applications and computing. They are gradually becoming less relevant with respect to the affect technology has on people's everyday life in Western society.

1.4. FOUR OBSERVATIONS, RESEARCH QUESTIONS, HYPOTHESIS, AIMS AND OBJECTIVES

At the outset of my research the following four research questions were developed, starting firstly with some observations, secondly the formulation of a research question and thirdly the formulation of a hypothesis.

1.4.1. On perceptual symbiosis

One observation was that when users are immersed in haptic and corporeally manipulative installations they appear as one out of many elements in a larger context. They seem to lose themselves in immersion. Such an experience of almost complete sensory immersion is similar to Husserl's concept of Lifeworld as the entire worldly background and starting point for human experience and reflection (section 5.4.2). Husserl's notion of the Lifeworld and Merleau-Ponty's intentional arc (section 4.1) both function as holistic key concepts by summing up all (human) multidimensional experience. The users' articulations and seemingly more intensive experiences within haptic-based installations can be read as an expression of this.

The *first research question* follows out of this: Do haptic stimuli contribute significantly to the sense of immersion? If they do, what new qualities does the tactile stimulation in interactive environments represent?

The *first hypothesis* is that users of interactive media installations will have an enhanced sense of presence, immersion and of 'being there' if they are exposed to a tactile/haptic interface responding directly to and on the body. Precedents for this are e.g. Brenda Laurel who comments: 'Given a multisensory environment that is good enough, people engage in projective construction that is wildly elaborate and creative' (Laurel, 1993:208).

My aim to test this hypothesis is through participatory observation and visual analysis of the users of my projects

My objective with this is to develop an understanding of cross-modal combinations based on touch.

1.4.2. On sensory resolution

A *second observation* was that users of interactive and multisensory media installations involving the body as a part of the interface appear to be more perceptually ‘puzzled’ than in mere audio-visual installations.

This leads to the *second research question*: Is there a close, quantitative connection between the number of sensory channels, their resolution and the influence on perceptual experience?

Following this, the *second hypothesis* is: The higher the resolution of the tactile/haptic interface in a given interactive experience, the more immersive and ‘real’ the tactile fidelity will be perceived. Haptic fidelity as the sophistication of sensations (Paterson, 2007:12) will be discussed in relation to development of higher sensory resolution in bodysuits in chapter six.

My aim is to test this hypothesis through constructing various haptic bodyinterfaces with varying degrees of tactile resolution.

My objective with this is to develop better bodysuit designs.

1.4.3. On the real virtual sensation

A *third observation*, during my *sense:less* and *Solve et Coagula* installations (chapter four), was that some users of the multisensory installations expressed perceptual sensations of physical phenomena that were not really there, like movement and being pushed and pulled.

This leads to *research question three*: How is our perception modeled, shaped or even manipulated by interactive and tactile interfaces? What can this phenomenological experimentation teach us about the psychology of perception?

Following this, the *third and weak hypothesis* is: Through certain conjunctions of sensory channels of a given multisensory interactive installation –like sound with image with touch- the distinction between virtual and real is blurred. The e-skin project of J. Scott supports this in showing how tactile and sound perception can support visual forms of interaction for visually impaired (Section 6.2.2. and Hauser, 2008:69).

My aim is to test this hypothesis through the construction of a multimodal interactive installation (the *Erotogod* project) and see if and how user experiences change with varying degrees of sensory experience. I will also look into cross modal perceptions such as ‘seeing the feeling’.

My objective with this is practically to develop improved ways of telling haptic stories through better combinations of multimodal stimuli.

1.4.4. On the possibility of haptic expressions

The *fourth observation* was that certain patterns and events in the bodysuit seem to trigger similar reactions and perceptions for different users. These common reactions indicate an intersubjective experiential haptic vocabulary.

This leads to the *fourth research question*: How can a haptic vocabulary composed of general expressions like Braille and Tadoma (section 3.2) be formulated?

Lastly, following my artistic work on haptic expressions is the *fourth hypothesis*: The haptic expressions that I have developed and utilized can be transferred to other contexts to trigger similar experience of haptic sensations.

My aim is to test this hypothesis through development of a general technique that can be used in other contexts and projects.

My objective with this is to practically develop an adequate haptic vocabulary and to better understand the phenomenological dimension of touch.

1.5. RESEARCH AIMS, OBJECTIVES AND GOALS

In general the research aim and objective of this thesis is mapping the problems and questions of haptic expressions and technologies. With this multifaceted goal at hand, another concrete objective of this research work is to describe and demonstrate how touching and being touched is affecting our experience and feelings inside media-based worlds.

The driving scientific interest of this thesis is to establish:

- A technical understanding of what a haptic language can be and how to develop that into effective ways for haptic storytelling. In my own projects I have continuously developed new approaches and new touch patterns in more than five body-based haptic projects (cyberSM, Inter_skin, SeC, Erotogod and Inter_skin II). These projects represent a (tacit) knowledge that possibly can be formalized in order to share it with others. The purpose of such sharing is to generate a higher awareness about the possibilities of haptics as well as to contribute to a qualified discussion about it.

- A theoretical framework for the understanding of the haptic language. Just as computer code is a language to build new meanings with (as computer programs, graphical user interfaces etc.), an understanding of why and how haptics function will be useful not just for gaining better knowledge of the field, but also developing new applications.

- An emancipatory and focused use of the results of the thesis. It can be argued that all art is political in the sense that it makes a case of what is valuable or not (Holt, 2001). Examples are found in the Fluxus, Situationists, Futurists movement and others. One motivation is to explore the relation between the experimental media artist and the political conditions that influence our technological choices. Art matters, and it is one of my aims to

show that and discuss how artistic experimentation is important both for science, the development of technology as well as our culture.

1.5.1. Approaching touch through art

How does one scientifically approach the experience of touch in art? How does one empirically watch, observe and prove findings? To do so a consistent and methodological approach is needed. Within the arts a rigid system of thinking is often seen as going against creative activities. As chapter two explains, such ways of thinking are often seen as too narrow minded. In this thesis scientific methods are tools to think and work with. They are about putting thinking into system. They also describe how results are found, and how it is possible to recreate them. Through the artistic research presented here, it is my intention to demonstrate how artistic methods can function as navigational instruments that guide us to new knowledge. In addition to the development and adaption of a bricolaged and partly autoethnographic methodology (section 2.5.1) I use a range of data for my analysis. These include observation of others, evaluation of video recordings, questionnaires and self observation. The specific methods and context of my research will be further discussed in chapter two.

This thesis is written in the context of art and artistic workspace. It is both because it is my field of training and because art - and media art in particular - is an open and experimental environment. In the tradition of the Avantgarde (Julius, 2002:200), almost any approach and strange idea can be worked on and developed. As an artist and professor for many years I root my personal and professional interest within this domain of creative culture. My writings are inspired by this field of creative endeavours and founded on my artistic work with media and technology since the early nineties. The experiential work of art has always been at the centre of my practice-based building of knowledge. The reasons for this are many, but perhaps primarily because of the intrinsic self-referentiality in the arts. Artworks tend to refer to themselves in their construction of what appears as an inner, self-referential process. Relational art can be read as an example of that (Bourriaud, 2002). As Luhmann points out, as a social phenomenon art is self-referential (Luhmann, 2000:176 and Tymieniecka, 2004:126). There is no right or wrong art (Hauser, Northkoth, 1982:225). Art is not 'true' or 'untrue' like a scientific theory. It is judged 'better' or 'worse' depending on the social context, presentation and perception of it. Examples of the openness of the experimental art scene are found from the classical Avantgarde of the Futurist movement to media artists like Naoka Tosa's '*Neuro Baby*' project on artificial intelligence, which built a computer-generated character that emotionally understood and reacted to visitors (Tosa et al., 1995; Sommerer and Mignonneau, 2004; Wilson, 2002:794). Unexpected and new approaches

to problems of artistic nature can have the advantage of letting strange ideas be realized.

Within the framework of art, knowledge becomes a transitory phenomenon. It is an interesting disturbance on a 'plane of immanence' and is found in the transitions between different states of mind and perceptions (Deleuze, 1994).⁴ As an artist trained in Norway in the 1980s and 1990s I was taught to intuitively sense how an artwork impresses my senses and perceptions whenever I am confronted with it. According to this romantic approach (Fenner, 2008) art should have a direct access to the senses and emotions.

In this way – as I learnt it - art was a straight way into direct, corporeal impressions. Its knowledge was to be based on 'intuition' and physical immediacy. This understanding of knowledge is tacit, or silent (Polyani, 1967; Schön, 1983). It is expressed corporeally, not verbally. The advantage of such 'silent' concepts is that they escape what Feyerabend calls the tyranny of other concepts like 'truth', 'reality', or 'objectivity' (Feyerabend, *Killing Time*:179 and Hannula, 2005:39). Yet, no matter how much one tries, such an approach still represents a conceptualization of knowledge.

Over time, I have come to appreciate that conceptual manifestations of actual experiences could make my work stronger. The practice-based artwork that this thesis is built upon, *Erotogod*, is the starting point for such a development. Over the years all my works with haptic stimulation and haptic technologies seem to follow a red line. Even though my artistic work has never before had a systematic presentation, it has long since become a systematic practice. Combining an artistic, informal approach to practice-based research with the formal research work (here represented through this thesis), is intended to make my practice more thorough.

Art as a field for the production of information and knowledge has been the underdog compared to scientific method and the truth produced in science (Hannula, 2005:34). One aim of this thesis is to illustrate that artistic knowledge in no way needs to be inferior to, but rather supplements and expands the way we construct, understand and utilize scientific knowledge. As with the development of new technologies, radical changes like the first Apple computer often come from the outside and outsiders. The next section will therefore focus on one of the fundamental problems to art and design.

⁴ Deleuze envisioned the world as a '*plane of immanence*' (Deleuze, 1994:35). Here phenomena such as knowledge and concepts appear as disturbances along the surface of that plane. Strictly speaking we live in the 'flatland' of this plane. Meaning resides in disruptions and disjunctions rather than in a flow of continuity that are naturally pleasing and assuring to us. While for Deleuze this is generally valid, for me this is especially valid for knowledge within the framework of art.

1.5.2. Wicked problems in art and design

The computer plays a central role in the media arts. Both as a tool and a concept it enables new forms of thinking and creativity (Sevaldson, 2005 and Rosenberg, 2004). Even if it is not at the core of this research there are several interesting moments in the history of computing and creativity that are relevant for the development of my approach to virtual touch. My work on touch was inspired by the thinking I encountered in the computing world at the time between 1991 and 1992. The historical and technological conditions proved to become important for how my artistic work developed towards new media and haptics. 'New media' is a term covering a wide range of definitions, both as devices, practices and social arrangements (Lievrouw and Livingstone, 2002). Here the term is understood within the developments of digital technologies where the most central device is the computer.

The computer is a device that has changed its fundamental properties radically since it was invented (Dourish, 2001:25). Many of the ideas that influenced the development of computing came from people and projects on the outside. The history of the Apple computer is an example of that (Allan, 2001:10/1). The first personal computer for the mass consumer was literally built in the living room of Steve Jobs' parents in the 1970s. Creative ideas like the early Apple or many artistic ones rarely find support in the instrumentally-oriented business sector. During the first years of Apple it was largely ignored because the business focused on large mainframe computing. Another example is *'Myst'*, the interactive quest game that came 1993 and revolutionized both computer games and increased the worldwide sales of CD-ROMs (Jenkins, 2002:487). It was also a living room- and self made project by the brothers Rand and Robyn Miller, but it hit an unexpected nerve in the market, something others had not done or thought of before.

The Apple project described above illustrates also an example of a 'wicked problem', where few of the many in the computing industry at that time realized the large, partly unspoken, unformulated interest in computing personally and at home. When Apple worked out the solution of a fairly cheap and open personal computer, the social problem - in this case a need and huge interest in individual ownership and working with computers - was stumbled upon. Other known wicked problems include economic, environmental, design and software development and even political issues. Wicked problems are of dynamic and often social nature. They rarely have one, simple and easy solution. There may exist many alternatives to solve wicked problems. Some are better, some are worse, but none need to be right or wrong (Rittel, 1973).

My work with haptic art projects started out as a wicked problem. My first experiences with haptic technologies showed how they fascinate and intrigue people. Seeing, thinking, acting and feeling through media art can

appear as magic and magically real. For example sensations of presence despite distance trigger our fantasy and interest: I feel someone, how can I feel them? Who are they, what are they doing? Questions like these were expressed by many of the participants in my early telecommunicative projects cyberSM and its follow up project Inter_Skin (section 4.8.4). During the cyberSM performance and demonstration of the tele-tactile communication system in Espace Kronenburg in Paris in 1993, the two user system was also presented locally. In a memorable event, one participant placed in a separate cabinet on a different floor literally jumped out of the bodysuit to run to the large auditorium to see the other participant he had been telehaptically communicated with. He had to see the other person. He also had to physically confirm the reality of the physical stimulation. This one example demonstrates how touch adds to the experience of telepresence and makes it potentially richer. In Paris, it had an overwhelming aesthetic effect, in the Aristotelian notion of aesthesis as our sense faculty (Paterson, 2007:19). The experience of touch seemed to affect the users intimately, resulting in directly affected bodies. This *affectus* is something that pushes or moves a body without the user necessarily knowing why. Affect and touch will be further discussed in section 3.3.

Without really knowing why or what, I had built something with cyberSM that people liked and triggered their interest. That indicates the ‘wickedness’ of the project: I had come up with a (artistic) ‘solution’ before I had a (formal) problem.

The rather new area of haptic technologies represent an experimental field where artistic experiments freely can explore how users can both touch and be touched inside a virtual space. This is an example of *research through practice* (see chapter two and four). Here the potential of technologies and a corresponding new practice is developed through experimental application of new technologies into prototypical (art) projects. As Birger Sevaldson observe on the affect of digital technology on design processes, new technologies can inspire designers – and artists alike - to ‘*develop richer and more varied approaches where traditional ways of working are part of the whole*’ (Sevaldson, 2005:10). This is consistent also with Feyerabend’s view of the importance of free experimentation and creativity in the progress of scientific thinking (Feyerabend, 1975). Without experimentation and diverging from the familiar, nothing new is ever born (Hannula, 2005:112). One of the differences between scientific and artistic research through practice is that in the science the results usually feed back in two directions: i) a redevelopment of practice into more applied research and methods, and ii) a development of new technologies. In the latter, artistic research contributes to developing new technologies through accepting – at least instrumentally speaking - ‘failures’. In art, especially if we see art as a social

system, making the better mistakes can be, artistically speaking, better than making no mistake at all. Artistic research is about daring ‘*to open the window, to jump out of it, enjoying the flight, views and landing*’ (Hannula, 2005). This represents an active stance towards knowledge and knowledge building which is interesting to opening up the field.

Haptic technologies add a sensory dimension to current VR systems that are mainly based on audio-visual output. By adding touch to such immersive realities, an expanded multisensory space emerges. Multisensory stimulation implies that more than two sensory channels are at use. Tactile technologies are those that produce a sensation of touch or being perceived by touch. A challenge for the future is what kind of wicked questions will come up as we increasingly find ourselves interacting embodied with and in the Lifeworld. As Paul Dourish tells, embodied phenomena are those we encounter directly rather than abstractly (Dourish, 2001).

1.6. TERMINOLOGY AND GLOSSARY OF TOUCH

This thesis is aimed towards understanding the experience of touch in the context of art. The use of concepts and keywords in the relatively new fields of research related to media art is often confusing and the terminology is often non-consistent. It is therefore helpful to organize the use of the different and vague concepts.

One common confusion encountered in the discussion of touch is the mixing up of what is *haptic* and what is *tactile*. The tactile dimension produces a specific sensation of touch or being perceived by touch. This is often used synonymously with haptic, which is the more general terms referring to what relates to or proceeds from the sense of touch. Haptic stems from the Greek *ἥψη* (Haphe), meaning pertaining to the sense of touch (Redondo, 2009:30), or possibly from the Greek word *ἥπτεσθαι* haptesthai meaning ‘contact’ or ‘touch’ (Kurfess, 2004:23.1.2) The two terms can be distinguished from each other in the following manner (Mark Paterson, 2007:IX): Haptic relates to the sense of touch in all its forms, including *proprioception*, *vestibular* and *kinaesthesia*. The tactile can be described as pertaining to the cutaneous sense involving the receptors embedded in the skin (Lin & Otaduy, 2008:2), and more specifically the sensation of mechanic/physical pressure rather than the temperature or pain. Both the haptic as well as the more specific tactile sensory modality is an active sense often used to explore our environment. Within this active sense, the tactile and cutaneous system is ‘passive’, receiving stimuli, whereas the *kinaesthetic* system is ‘active’ and related to movement as perceived by receptors located in muscles, tendons and joints. Overall the tactile experience is a specific instance of a general haptic experience. A haptic experience could involve a tactile dimension, but not necessarily.

As initially stated the tactile (haptic) sensory modality is an active sense commonly used to explore our environment. This will be further discussed on haptic vocabulary, - language and - storytelling in chapter four and six. Tactile interfaces are all the physical sensors (measure input/touch) and effectors (impress output/touch) that provide us with a sense of touch at the skin level. *Haptics* is the technology that connects humans to a computerized system via the senses of touch by applying forces, vibrations and/or motions to the user. The haptic vocabulary is here a set of haptic expressions that enable the design of particular experiences made of touch.

Haptics allows us to feel and manipulate virtual objects and make digital objects sensual (Hawk, 2008:212). Examples of such projects are *Osmose* by Char Davis (Paterson, 2007, Grau, 2003:193), which enabled the users to access a virtual world by breath activated interfaces (Wilson, 2002:188) and *BodyMaps* by Thecla Schiphorst (section 4.7.4) where the users activate a projection of a woman onto a table by touching the table itself. My own works (cyberSM and Erotogod) expand on such touch derivative projects by actively and deliberately projecting touch back upon the body of the participants. For me, the user sensations of touch are integral part of the artistic material and project. How and why will be elaborated on throughout the thesis.

From my perspective, new multimodal and corporeal approaches to the media-made spaces of experience open up for new interplay of the senses. According to McLuhan this forms thinking and communication (Meyrowitz, 1986:19). This in turn facilitates social and cultural changes, which already can be seen. We tend to disregard that haptic technologies have become a part of many people's lives. For example all mobile phones now come with vibration mode. Even if turning off the ring tone you can still feel when someone is calling. In gaming all major game consoles have vibration feedback. So you can feel when your car crash or, as with the Nintendo Wii video game console, you can feel it when you hit the golf ball with your virtual blow. Such vibrotactile haptic stimuli and feedback can contribute to a heightened sense of experience and control. And they are only the beginning of what can be called *haptic realities* (HR) where the boundaries between the virtual and corporeal are blurred.

A central terminology used throughout the thesis is *Virtual Reality* (VR). VR is an oxymoron (Ihde, 2002:xiv), but is of many reasons central to my thinking around haptics. One is that VR is so fundamental for the development of computer mediated environments, another that the VR hype of the 1990s put a sharp focus on the virtual representation and 'immaterial' experience of the body (Ryan, 2001:322). The notion that something is immaterial because it is electronically experienced is a superficial trick of perception. Throughout the thesis it will be clearer why VR is not immaterial,

and why it cannot be so. Now new technologies lean toward including physical expressions and personal communication that affect the user's real body - for haptic stimuli are for real. You cannot shut your eyes against it. *Touching technologies* affect your body directly and in ways that are unmistakably intimate for the user. The senses of touch are multiple, complex and intertwining (Patterson, 2007:6) from the proximate and cutaneous skin contact to the remote, distanced perception of touch on inputs of sight and sound. This thesis will discuss this further and show how to negotiate 'virtual' intimacy, explain how it can be done and experienced.

The following is the beginning of a glossary of touch in alphabetical order. It attempts to clarify how the various central concepts are used in this thesis (based on Mark Paterson, 2007:ix):

- **Cutaneous:** pertaining to the skin itself or the skin as a sense organ. Includes sensation of pressure, vibration, temperature and pain.
- **Epidermis:** outermost layer of the skin.
- **Ergonomics** is the study of the physical characteristics of interaction. My work with tactile stimulation implies that ergonomics is an important issue for how users can feel and interfaces can be felt.
- **Haptic:** relating to the sense of touch in all its forms. Also used to describe *active* touch (Grunwald, 2008:33 and :251).
- **Haptic language** – a set of touches that produce some form of meaning.
- **Haptics** refers as well to the sense of touch⁵, but is also used to refer to fields relating to the haptic domain. This can be the study of touching behavior in humans, but also related to engineering and the making of tools that enable haptic stimulation, expression and sensation.⁶
- **Kinaesthesia:** the sensation of movement of body and limbs. Relating to sensations originating in muscles, tendons and joints.
- **Multisensory stimuli** is the combination of two or preferably more than three sensory channels. One example is combining sound, vision and touch.
- **Proprioception:** perception of the position, state and movement of the body and limbs in space. It includes cutaneous, kinaesthetic and vestibular sensations. It is a specific sense and distinct from for example kinaesthesia, but sometimes confused with it (Haans, 2006:27).

⁵ <http://en.wikipedia.org/wiki/Haptics> accessed on March 27th 2010.

⁶ See International Society for Haptics, <http://www.isfh.org/haptics.html>, accessed on March 27th 2010.

- **Sensory resolution** is about to which degree an object can be sensed as that specific physical object through touch.
- **Somatic**: the term somatic refers to the body, as distinct from some other entities, such as the mind. The word comes from the Greek word Σωματικός (Somatikòs), meaning ‘of the body’.⁷
- **Somatosensory system** is the biology of sensory receptors.
- **Tactile**: pertaining to the cutaneous sense, but more specifically the sensation of pressure (from mechanoreceptors) rather than the temperature (thermoceptors) or pain (nociceptors). Also used to describe *passive* touch, i.e. touch perceived without any muscular effort (Grunwald, 2008:251 and :321).
- **Tactile interfaces** are all the physical sensors/actuators that provide us with a sense of touch at the skin level. Often used synonymously with haptic interfaces.
- **Vestibular**: pertaining to the perception of balance, head position, acceleration and deceleration. Information obtained from semi-circular canals to the inner ear.

1.7. PERSONAL BACKGROUND AND MOTIVATION

This thesis is built upon my experience with designing and building haptic installations and interfaces since 1989. In particular my works on bodysuits starting in 1992 have been used to create interactive, multisensory art installations. The starting point for my interest in intimate corporeal experiences, however, was in architecture.



Figure 1-1 Three different large scale structures built by Leca concrete blocks, 1990.

From 1990 to 1991 I built a series of large scale, physical building complexes in concrete. These were built as artistic installations and measured up to 30 meters in length and 3 meters in height. The constructions were formed as labyrinths composed by sequential corridors and spaces with no real purpose or function. The walls were of a homogenous texture and so tall that no

⁷ <http://en.wiktionary.org/wiki/somatic> accessed on March 27th 2010.

external point of reference for navigation was visible. Through these experiments and inside these structures I noticed that my perception changed. The structures had a haptic effect on me. I did not need to touch the structures to feel different. They share presence through the larger-than-human scale of the constructions, their lighting, my placement before the monotonous surfaces and inside narrow corridors of the structures affected my sensual impressions. In particular I experienced disorientation. In some cases it was so strong that I had physical reactions on the verge to nausea. These strong personal experiences have inspired me to take account of autoethnography as one of my methodologies for studying touch (chapter two).

Around the same time as I built these structures I personally experienced how our vision is influenced by the brain. During a scuba dive to approximately ten meters depth in water filled with mud, the light was refracted in a manner so that it appeared to come from nowhere and everywhere. What one then sees is a monotonous field of vision with no contrasts, depth, edges or objects. Under such zero-contrast conditions where the eyes have no object to focus on (Driggers, 2003:494) the visual percept rapidly fades and may even disappear. Such phenomena are known through research on fixational eye movement. I started to experience a vertigo like feeling and hallucinations appeared as my faculty of seeing started to produce its own visual material like dots and colours. This and similar hallucinatory phenomena are known to divers (Rossier, 2001), and the trick to avoid such loss of vision is simply to put the hand in front of one's goggles. With something to see, sight immediately returns. That lack of visual reference can lead to disorientation and vertigo is also known to pilots, which is why they must rely on instruments - even if they think they know where they are. Similar sensory illusions caused by deprivation in darkrooms has been observed and documented by Jack Vernon (1960). Sensory deprivation is also a technique to influence perception. Used over short time as in flotation tanks, it can be deeply relaxing and even promote learning (Coon and Mitterer, 2008:198). However, if experienced for longer periods it can function as torture. The infamous images of prisoners at Guantanamo bay⁸ show them blinded with masks, hands tied and unable to touch anything due to gloves, their hearing disabled through earphones. Over their nose and mouth they wear a mask that probably filters out smell as perceptual clue. Such blocking from environmental input signals is an effective method to make the body produce its own input. Research has shown how people then experience strangely distorted perceptions, stressful and disorienting situations (ibid, p. 198).

⁸ Link to image: <http://www.dailymail.co.uk/news/article-513975/Democracy-trial-Guantanamo-Bay.html> accessed on March 27th 2010.

Such and similar perceptual experiences became both an inspiration to as well as a result of my early artistic work. I wanted art to be able to produce a similar and complete perceptual immersion. My goal became to make art that leaves a physical impression. Artists with similar focus and perception manipulative techniques – even if not always outspoken - are Anish Kapoor and James Turrell. In Kapoor's sculpture *Marsyas*, shown 2002 in the Turbine hall at Tate gallery, London, he creates such a massive and homogeneous sculpture that the perceptual experience is that the work completely permeates physical and psychological space (Jodidio, 2004:352).

An example of how visual perceptions are haptically perceived is experienced in James Turrell's work *Perceptual Cells* (Kossolapow, Scoble, Waller, 2006:301). In this series of one-user chambers, the visitor – looking into a sphere reflecting light without contrasts - can immerse him/herself completely in light. The frequencies, colours and intensities of the light can all be controlled by the viewer.

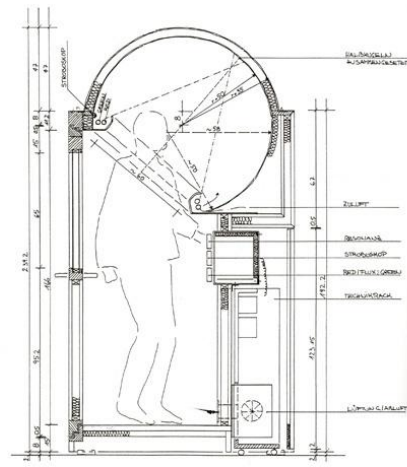


Figure 1-2 James Turrell, «Perceptual Cell», 1991, Photography | Photograph: Michael Herling / Aline Gwose
| © James Turrell, From <http://www.medienkunstnetz.de/works/perceptual-cell/>

His intention was to demonstrate how one's perception is changing due to altered light conditions. Changes in light not only influence the visual senses, but also what and how we feel with our bodies. I experienced these boxes myself in Düsseldorf in 1992.⁹ To me his cells confirmed my diving experience that moods and spatial impressions are affected, and possibly radically, by monotonous and immersive sensory experiences. This happens

⁹ James Turrell's exhibition *Perceptual Cells* in Düsseldorf: Kunstverein für die Rheinlande und Westfalen, 1992.

even if other external parameters and conditions remains the same - like temperature and space.

From 1992 I continued my work with perception-manipulative structures at The Academy of Media Arts in Cologne, Germany. Here I ported my architectural ideas of monotonous constructions into 3D, computer-based animations of various architectural structures. One reason why I wanted to build computer-based structures was to build super-sized structures bigger than I could ever possibly construct in real life. The aim with the 3D simulations was to study their perceptual effect to see if they would be physically more imposing and profound.

These computer graphic (CG)-based structures could only be experienced as video. They were made so as to simulate the perspective and point of view of a human sized user. Even if projected on large screens they lacked the physical effect of my previous real life structures. If these visual expressions of space and movement were built to give an illusion of grand scale, why did they not impress me? Projections and screen-based imagery had in the early 1990s a maximum resolution of 720 x 540 pixels. This is too little to compete with the visual depth, complexity and impression of a real-life structure encompassing your body. Our visual acuity, that is the spatial resolution capacity of the visual system (McIlwain, 1996:143), is much higher. Estimates say up to 100 million pixels (Rooney, 2001:253). As chapter five will discuss, it is my impression that phenomenologically and physically being-there, being on-the-spot, is existentially important.

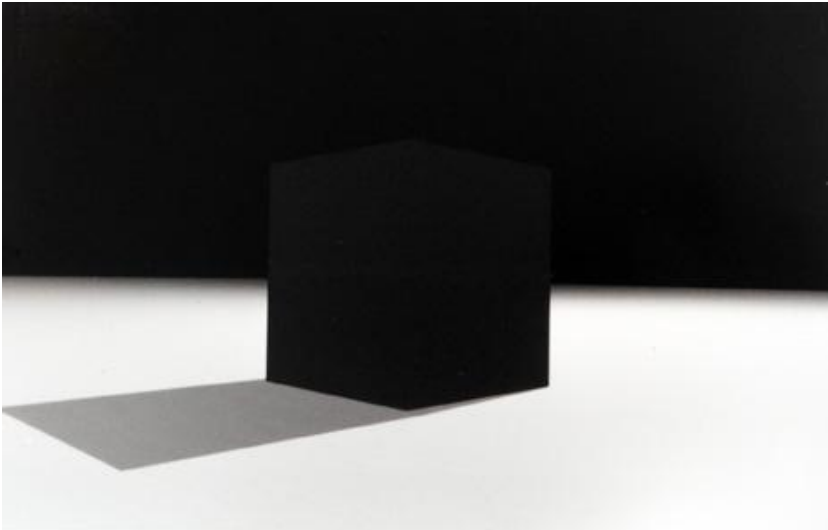


Figure 1-3 video still from endless looping movie around cubical structure (1992).

Through a series of incidents, and disappointed with the lack of corporeal impression in my CG-based structures, I was inspired to bring the realm of corporeal sensations into this so called ‘cyberspace’ of the 3D computer renderings. My interest in the technologies of touch started when I first began to work with advanced man-machine interfaces in the field of new media art in 1992 (cyberSM). I soon experienced how little we know about multisensorial art, installations and systems. ‘Multisensory’ here refers to sensory additions to the common combination of Audio Visual expressions. *First*, the technology was – and still is - relatively new, lacking stability and standardization. *Secondly*, because of the short history of interactive media, there exists few accepted theoretical writings and references on the topic. This calls for patch working and combinations of different kinds of sources for knowledge. *Thirdly*, without a common language of interactivity, how are the users of such works to be understood and analysed? Even if these problems of missing theory, weak empirical knowledge and undeveloped methodology are serious issues, they can also be seen as an advantage, calling for open mindedness, greater flexibility and adaptive design. Most of my initial sources for inspiration, theory and references are correspondingly ‘grey matter’, that is more informal writings and experimentations as found at conferences and proceedings about new media like Siggraph¹⁰ and Ars Electronica¹¹, new media art-exhibitions like DEAF¹² and various internet-based sites like Stephen Wilson’s.¹³ Such theoretical ‘gray matter’ is more often than not undocumented or hard to recollect outside of context. Until the start of my Ph.D. work my collection of data was partly ‘tacit’, that is based on personal, hands-on experience not formalized in scientific writing.

¹⁰ www.siggraph.com

¹¹ www.aec.at

¹² Dutch Electronic Art Festival, www.v2.nl

¹³ Stephen Wilson homepage has a large overview of various media art: <http://userwww.sfsu.edu/~swilson/> accessed March 27th 2010.



Figure 1-4 One of the two users in the cyberSM haptic communication system

In November 1993 I finished what is to my knowledge the world's first haptic, full-body, person-to-person communication system, the so called *cyberSM* system (see section 4.8). It was then performed publically for the first time between Cologne and the Voyages Virtuelles exhibition in Paris.

At today's distance this experiment with touch is technologically comparable to the first steamengine in its novelty and mechanical crudeness. Nonetheless it functioned, and again I noticed how my perceptual experience

- within the framework of long distance communication and through a PC - was affected, influenced and shifted. These effects, however vague they were present, were also indicated both by others and by my observation of them. The effects were a stronger sense of intimacy, presence and proximity with the other participant. CyberSM lets users feel each other bodies over distance, sharing their own body both as an object and its properties. This gives an experience of how presence can be felt at a distance (Paterson, 2007:127). Being able to telecommunicate physically and corporeally gave a stronger sense of connection between users. The strength of the corporeal sensation affected the way they acted. These effects were most notable in increased activity levels, focus and engagement.

Over time these findings led me to look for new models of interaction more suitable to create, explain and describe reality as it is experienced in such human-to-computer-to-human systems (HCH). One of my strategies to better understand why the haptic, human-machine-human project functioned so well and attracted its users, has been to reduce the overall complexity of the installations. What happens if one takes away visual elements and only experience with the body? As a consequence of this reductive approach I built the *Inter_skin* experiment (section 4.8.4). This approach was a consequence of what was my research method at the time, namely the systematic use of the spontaneous artistic process in all of its different forms as a primary way of understanding and examining experience. Without thinking much about it or having learnt it, I developed my own investigative method through a sequential exploration of perceptually manipulative art installations. My intuitive method was a 'making do', a bricolage (Michel de Certeau, 1988), an artisan like inventiveness, based on my everyday praxis of experiments, reflections and new trials building on previous results. Over time this has given me accumulated knowledge on how to build and utilize touch as both material and tool, even if this knowledge to a large degree is tacit and nonverbal.

Since the cyberSM project I have focused more on developing technologically advanced system designs with a much higher sensory resolution. To keep the projects as simple and easy as possible, I have reduced the number of simultaneous users from two till one at a time. Effectively my later projects like *Solve et Coagula* (SeC) (section 4.9) and *Erotogod* (Chapter six) have been stand-alone human-to-computer-interfaces, HCI. One reason for taking away the tele-communicative aspect is to better observe the user's individual perception in a local, proximate environment. This approach makes it easier to analyze and understand touch in the context of media-art and human perception.

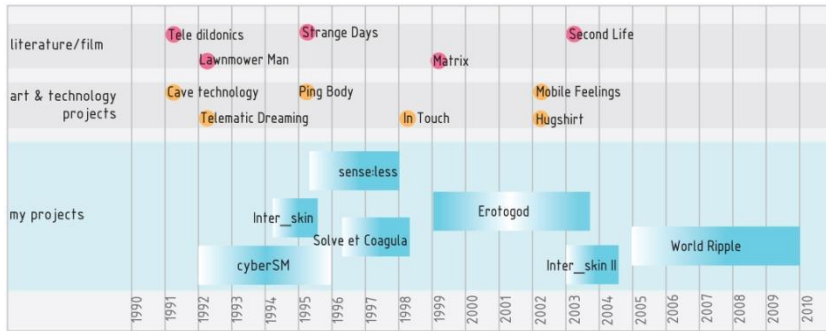


Figure 1-5 Timeline and timetable for the realization of my various installations in relation to other cultural and technological developments

The one-user installations can be considered as one terminal in a telecommunicative system, where the computer responds to the user as if it was an affective being. This might appear as having similarity to a Turing test where the computer tries to convince the user that it is a human (Moor, 2003:31). However, my installations differ in both practical and artistic goals, by putting the sensory stimulation at the centre and focusing on the user's existential experience. The technologies behind my one-user systems are built upon an open soft- and hardware architecture that can easily be expanded into a multi-user communication system. The implementation of haptics within two or more users telepresence systems are of great interest to me. As Haans and Ijsselsteijn (2006) note, social touch in communicative process can have wide implications. However, as my focus will be on the subjective sense of haptic stimulation, those implications will not be at the centre of this thesis.

1.8. FUTURE TOUCH

In the electric age we wear all mankind as our skin.
- Marshall McLuhan, *Understanding Media*, p. 47.

How can we better understand the effect of touch in the context of new media and technology? One methodological approach is to build scenarios showing how touch will be used. This represents a kind of descriptive hypothesis of the future use of haptic storytelling. Such scenario building makes use of subjective impressions and selective histories to construct a variety of possible outcomes. Scenario building says that if it does not let one predict the future, speculating on several outcomes one might perhaps hit upon it (Mintzberg, 2000:248). In this way it represents a methodology that can

actually guide development. The following section takes inspiration from such a speculative approach and attempts to describe some of the present uses, effects and trends of touch and how they will change in the future. It will also attempt to explicate how they affect our lives.

A global revolution is going on as an effect of emerging mobile and wireless technologies. In the near future we will probably see a continued technology driven trends towards the unwired techno-nomad, but also simultaneously experience a fundamental change in the way we merge together with advanced, non-local communication systems. Combined with increased computing speed, media resolution and focus on individual experience, we will symbiotically fuse with a world of experience that in effect has become a transparent, intuitive and naturalized interface. How? The ultra high bandwidth of future mobile communication will literally be like a skin that we wear on top of the natural one. With McLuhan we'll wear mankind as our skin that can reach out and touch anyone through a naturalized interface: the body. How will this affect us?

To give the human an eye for an ear is, socially and politically, most likely the most radical explosion that can happen in any social structure.
- McLuhan, 1962.

Media influence our perception of reality, and consequently can change the way we think, act and experience the world. It was with reference to the effect of the Gutenberg printing revolution that McLuhan pointed at the radical changes that happen when new media and corporeal media-extensions are introduced. Mobile technologies are such a new 'corporeal' media. An expansion of McLuhan's techno utopianism could claim that these emerging computer enabled environments will have a greater effect on our culture than all previous media-revolutions together.

McLuhan saw the coming of the television in the late fifties as a revolution. In his words this new technology exchanged an ear for an eye. Moreover, people were both moved and touched through television. The Vietnam War became a sign of how media and TV in particular can exert high affect on a culture. The TV significantly influenced American public opinion and some think even the course of the war (Berg, 1991). The intense use of TV coined this war as the first 'Television war'.

Although the area of personal computing is changing, the Personal Computer (PC) is still a part of the desktop simply because of its heavy weight alone. That also goes for low-weight laptops that are still what they are called: something sitting on your lap. They are not made to be used while walking. Limitations in the PC usage are often caused by the office like use

of computing. We commonly think of, and use digital technologies like an office space. Seen from the outside it appears as if most computer users serve in front of the machine, and experience the digital world through the older metaphor of the *camera obscura* (Kofmann, 1999), contemporary represented as images on the screen. More than the computer screen – as in Microsoft's *Windows* metaphor – is being a window to the world, it might obstruct our view of it. What if computing was not visible? If it made no sense for users to sit down and look at what happens? What if the user's body became like the computer screen and - based on physical input and output - became where the action really takes place?

With the rapid introduction of mobile technologies this change is occurring now. The new generation of school kids born in the 1990s and later are called '*new millennium learners*' (McCain, 2000:121) because they have a casual, transparent, intuitive and almost natural way of using digital technologies such as mobile phones, the internet, chatting, Facebook etc. This has resulted in a certain cultural gap between those born before and after the mass-market for these technologies.

Currently our consumption of digital media is becoming content in its own right. Blogging, Facebook and Twitter are examples of how people's own activities are both enabling and driven by new digital technologies. One future scenario for the current mobile computing revolution is that we will see the establishment of interactive systems built around wearable, intuitive and haptic designs as the new paradigms of interactivity. This is not necessarily to be seen on a screen, but perhaps sensed as a result of the re-wiring of our perception through multi-modal, computer enabled environments. This rewiring is a result of the mentioned advances in attaching the machine and the human. First adding mobility to phones, then user-tracking through GPS with live video are such new multimodal possibilities that have already come through.

One example how this affects our *technocultural* behaviour is how the new iPhone comes without a user manual (Pogue, 2009). It is supposed to be so easy to understand that you don't need a manual. The natural development of such transparent system functionality leads to the disappearance of the interface. In such a scenario, technology becomes a second nature where our use of it has become transparent to us. This implies that the interface is experienced so natural that users need not reflect upon their use of it. A likely development of this is the disappearance of the interface. In the future we can therefore expect to see the development of disappearing interfaces as a trend. Touching is in itself an intuitive and natural way of interacting with the world. In this sense the best interface is perhaps an invisible interface, which is a non-visual, non-intrusive technology that is not directly experienced as a surface of mediation (Streitz, 2007). What if the skin itself becomes an

interface? With the advances of mobile phones like Iphone and its touch-based interface, it appears that such a scenario is being realized.

Since the mid-nineties the telecom industry has developed in a different direction than the desktop industry. In telecom engineering a trend to merge the computer and the mobile phone can be observed. One example is the merger between Google and the mobile phone through the Android open source software.¹⁴ The transparent, skin like interface is realized by developing computing technologies and applications that are i) non-visual, ii) oriented toward the individual (user) and iii) tied to the body of the user. Non-visual interaction is here naturally occurring since phoning function well without screens. The success of the mobile phone is based not on its audio-visual capabilities, but on its audio-mobile-connectivity. Secondly, mobile phones are personalized technologies. Such an intimate technology makes your phone number synonymous with your name. When the emerging 3 and 4G mobile phone networks add hard-core computing and communication technology to its audio functionality, these personalized, intimate applications will be further integrated into our environment. As Steven Johnson remarks, technologies and designers open up whole new possibility spaces for the designers that come after them (Johnson, 1999:227). Therefore, and thirdly, as they are small enough to be integrated with your body, it is simple to speculate on what comes next: natural extensions as the inclusion of corporeal functions, biometrics and – further along the line - ‘emotional computing’ (Jones, 2003). Combined with GPS tracking of user’s geographical coordinates we can even expect URL’s to be expanded by time and physical space coordinates. A homepage thematizing the 9/11 accident can –for example- only be accessible when you’re on site at Ground Zero. And it is only open at the exact time of day when the planes hit the World Trade Centre towers. Such a *geotagging* addition to a web address (URL + place + time) twists the consumption of media/content towards a need for personalized attention, individual focus and physical presence. The emerging trend of so-called social computing and web 2.0 exemplifies the cultural transformation due to technological advances. In the words of McLuhan (1962): ‘*Technological environments are not merely passive containers of people but are active processes that reshape people and other technologies alike*’. Through connectivity we create and take part in a collective intelligence (Pierre Levy in Murphie, 2003:157). The simplicity of the desktop metaphor is gradually expanded from tool into a virtual medium (Johnson in Hawk, 2008).

As this demonstrates, we currently observe a cultural change where technologies are getting closer to the body and users’ needs as they are on the

¹⁴ <http://code.google.com/intl/nb-NO/android/> accessed on March 30th 2010.

move. This opens up for the field of haptic technologies. To design and construct haptic technologies as used in my interfaces also involves the fields of 'ergonomics' and 'haptics'.

1.9. ERGONOMICS AND HAPTICS

There has been a long tradition of seeing the human as subordinate to a transcendental technological world. As a counter-genealogy of new media experimentation, Anne Munster (2006:21) proposes to place human bodies as the key to computational engagement. If we find the body to be more important than technology, the question of how we practically and functionally can *put the body at the centre* still remains. The practical and functional approach towards design problems is one of the core issues of ergonomics.

My work with tactile stimulation implies that I also work on interface development, that is development of new technical possibilities to produce sensations of touch- as well as on ergonomics – *the study of the physical characteristics of interaction* (Dix, Alan; Finlay, Janet; Abowd, Gregory D., 2004:321). Some disagree with this definition of ergonomics and emphasize that the cognitive, social and organizational aspects of design must also be taken into consideration (Booth, 1989:8). Also, as Jordan writes in his book on *Designing Pleasurable Products*, designers are 'increasingly expected to have an awareness of human-factors issues and to put them at the centre of the design process' (Jordan, 2000:1). This can be read as a shift in users demand as a result of culturally dependent factors. In 2010 we live in a time inspired by the Iphone design, where gadgets and technologies should ideally come without a user manual. As discussed, technologies and experiences that users desire and demand are increasingly oriented towards the body. The ergonomics of haptic technologies is a new and barely explored field. For the development of a haptic language, this is also an area relevant for further in-depth description and discussion. As ergonomics can be considered as a specialized field of research with its own traditions, my intention is simply to touch upon some of the characteristics and approaches that this has in common with my own artistic research. Ergonomics is important for the better design and functionality of bodysuits and other wearable haptic technologies. One particularly relevant ergonomically question is how to fit bodysuits to our bodies. This issue will be discussed further in section 4.9.2 and chapter six.

Within the field of haptic studies, haptic technologies is in engineering terminology known as '*haptics*' (Paterson, 2007:12). It is a common term of applying touch sensation and control to interaction with computer applications (ibid, p. 13). Haptics allow for a more active exploration of virtual environments. In addition to seeing virtual objects on a screen, haptics

lets user feel and interact with them (ibid, p.128). The field of haptics is technologically-oriented. It is about facilitating and making technologies that can produce and convey touch. An example of haptics technologies developed is the FEELEX, a large, flexible screen that simulates the shape of virtual objects. Its aim is to let users feel virtual objects with their fingers as well as avoiding the user having to wear any extra apparatus (Grunwald, 2008:360). Haptics can so be seen as a 'new mechanical channel' for the production of touch (Paterson, 2007:128). The relationship between ergonomics and haptics is often unclear. Simplified it can be said that designing in a user-friendly way is a core issue in ergonomics and developing a technology that touch is a matter of haptics. For the latter, a particularly important goal is to design a convincingly enough illusion of being in a virtual interaction.

Relevant for my projects here is that ergonomics and haptics are both related to the design of the haptic interfaces I use. A variety of terms have been used, another that covers both the ergonomical and haptical is 'tangible computing' (section 4.6.4 and Dourish, 2004:15). The general term used in this thesis is simply haptic technology. That is also because my research relates to different traditions.

1.10. RESEARCH TRADITIONS

My practice-based research belongs to a long tradition of informal artistic research. Even if the development of my artistic touch projects might appear linear (Figure 1-5), they did not evolve according to long term planning. Rather they came about as a natural development of my evolving interests and as the result of tacit, unspoken knowledge (Schön, 1983). Artists have a preference of letting the work talk for itself, and not letting text talk for the work. However, for me there are clear reference points to where I have found and contributed to experimental artistic research and formalized knowledge building. The arenas for research in the arts, and within new media specifically, are usually specific events, festivals and meeting points such as:

- Ars Electronica – Started in 1979 it is a festival for art, technology and society. The interaction between art and technology, between man and technology is demonstrated in multi-media exhibitions, concerts, workshops and symposia. It takes place every year and its Golden Nica prize is the equivalent to the 'Oscar' of the media art world. Winning it confers much prestige. www.aec.at
- Banff New Media Institute - <http://www.banffcentre.ca/BNMI/>
- DEAF – Dutch Electronic Art Festival. www.deaf.nl, organized by V2 – Lab for unstable Media, www.v2.nl
- EMAF - Electronic Media Arts Festival <http://www.emaf.de/>

- ISEA (International Symposium of Electronic Arts), <http://www.isea-web.org>
- Japan Media Arts Festival (Tokyo) <http://plaza.bunka.go.jp/english/>
- Nordes – Nordic Design Research –a network of people interested in design research
- SIGGRAPH – Special Interest Group GRAPHics, held annually in the US
- VIDA - Art & Artificial Life International Competition (Madrid) <http://www.fundacion.telefonica.com/at/vida/english/index.html>
- ZKM – Centre for art and media in Karlsruhe, www.zkm.de
- The Interactive Institute, Sweden, <http://www.tii.se/>

Media art is also a research topic within the traditional academic structures of art education. Important reference sites are:

- New Media Art Schools like The Academy of Media Arts, Cologne, www.khm.de
- MIT media lab, <http://www.media.mit.edu/>.
- Stephen Wilson's homepage with a large overview of various media art, <http://userwww.sfsu.edu/~swilson/>.
- The ELIA network, Europe's largest network for art schools that organize various symposiums on art and research like the conference on artistic research at the University of Arts (UDK) in Berlin in 2005, <http://www.elia-artschools.org/>.

The question of how -and if- art and research goes together is currently a heated debate (Hannula, 2005). It is my hope that this thesis can contribute to this important and far from settled discussion. Personally I see the art field as an open arena that can promote different experimental kinds of research. Based on my own experience I also do think it is possible to produce a better art through research. The issues of artistic research as a unique research environment, how it can generate knowledge as well as which parts of artistic practice generate knowledge will be further framed and discussed in the next chapter.

1.11. ON THE USE OF MEDIA ART AS EXPERIMENTAL CONTEXT

The media arts provide us with a technologically founded aesthetic framework that encourage new ways to experiment with ideas and future scenarios. The established media art exhibition and conference *Ars Electronica* has a 25 year long tradition of employing cutting-edge

technology in order to go to the furthest limits of possible uses of future technologies. My artistic employment of technologically produced touch is one such future scenario, and the centre of this thesis. In constructing the experiment I saw it as essential to directly research the characteristics of touch in interactivity. I found out that the experience of touch is characterized by both a qualitative and technical dimension.

The qualitative and primarily experiential dimension describes different user-oriented aspects like multimodal interactivity as in the use of various two-way sensory channels; physical experiential phenomena as in sensual impression; ‘immersive’ environments that encompass the user in a media-based installation; personal and user-oriented systems which know *who* you are; context-specific experience that knows *where* you are; transparent (natural) interaction that is easy to learn/use; and finally a sense of integration where the user feels she or he is a part of the environment.

The technical dimension describes technological aspects that serve as the basis for generating a system that makes the qualitative dimension experientially believable. Issues at hand include context aware programming where the system is ‘aware’ of different meanings; multimodal interface design where different design technologies are combined; affective technology focused on individuals experience and identity; scalable media that adapts to different situations; mobile applications for transparent interaction; ubiquitous computing for making the environment around the users ‘smart’; action-based interfaces responding to users’ actions; multisensory output giving feedback in various ways; emotional recognition attempting to foresee a users emotion condition and needs; dynamic content scaling to fluxing states of a system; and wearable technology giving the users the freedom to move without being bound by mechanical, ‘clumsy’ technology.

1.12. SUMMARY AND DISCUSSION

The chapter has introduced the research questions and aims of the research. It has also framed them in relation to my professional background as an artist and my earlier work on perception manipulations through art. Seen in relation to the artistic works of Kapoor and Turrell, art is a field where the senses can be used to generate new impressions and corporeal sensations. Historically my approach is related to the technocultural developments that started in the sixties. Although the research traditions of the art field go way back, the research traditions of new media art are relatively short. To a large extent it happens in the context of festivals and symposiums. My approach towards haptic technologies and experiences is practical and functional. For me as a practicing artist it is most important that my installations provide meaningful haptic experiences. This involves also other fields like ergonomics and

haptics, but my approach must still be considered primarily artistic. My contributions to the field have been many over the years. One goal with this research is to contribute new visions for the future where body-based media promise to become a central issue. A personal goal behind this research is to continue to build a critically-informed artistic practice.

My work with haptic technologies (chapter four and six) has produced the following results:

- An overview of touch in the context of media art.
- A new way of using touch on full bodies inside immersive environments.
- Designing bodysuits as tactile displays using electromechanical devices.
- A new haptic vocabulary that can be utilized as practical knowledge in the making of haptic storytelling.

The next chapter will look at how I found my way of doing practical research in the arts. It serves as a background to this thesis, attempting to explain some of the complex issues influencing my work and my approach.

2. ARTISTIC RESEARCH – FRAMING A METHODOLOGY FOR HYBRID CASES

This chapter first frames the questions of methodology and knowledge production within the current debate about practice-based research. It is a field with many open questions. What is the relation between art and research? What knowledge does artistic research generate? What is the difference between art practice-in-itself and art practice-as-research? The second part of the chapter explains how I chose to do my artistic research and is a route map describing the actual methods applied during my practical art experiment. Titled ‘Erotogod’ the experiment was an empirical and practice-based research on interactive, multisensory and immersive experience within computer-mediated art and in the context of visual art. This chapter presents –in addition to the description of the ‘art-as-research’ practical experiment– the methods of i) empirical practice-based research, ii) user interviews and iii) user observation as tools to systematically create knowledge within the making disciplines. The complex and multifaceted character of practical-aesthetical experiments demands bricolaged and interdisciplinary methods, therefore I use the term ‘hybrid methodology’ to describe my scientific work.

2.1. INTRODUCTION

Hybrid media require hybrid analysis. - Lunefeld (1993:7).

How can touch be explained from the point of view of the arts? Contextually this thesis is written within the fields of interactive and computer mediated art. It attempts to understand how users experience touch inside multisensory, technologically-based and interactive environments. This framing is challenging because it is a new, growing and interdisciplinary field

undergoing rapid changes and development. Media arts based on digital technologies have a relatively short history since they were not possible to make before the computer was invented (section 4.1). The short time of existence also cause a certain lack of references, especially when I started out with this investigation in 1999. The lack of scientific investigations and artistic projects with a similar practical-aesthetical focus then led me to look for alternative ways to research into my field of interest. Of course, unless one has a very special problem, finding a specific topic of interest and developing a title for Ph.D. research does not happen overnight. As I mention in chapter one, my road towards formulating a research proposal has been an ongoing, highly subjective process, influenced by personal observations, vague reflections and strong opinions that I have developed during the course of my many art experiments. Finding, developing and testing methods appropriate to artistic research is a lengthy and not a straightforward process.

In my case the road of writing a Ph.D. thesis can be described as an iterative process. In particular writing has happened in many small steps. At first I tried to formulate what kinds of problems might be contained in my practice-based art production. The next step was how to meet these challenges. My theoretical approach has changed a lot during this time and is definitely different from the initial proposal. The development of my research method has come as a result of my first open research questions. Methodological choices exert a major influence on the focus of a Ph.D. There is not much sense in having a hypothesis or field of problems if you can't systematically research it. Methodology is a systematic way of mapping problems. Over the last years and due to my search for scientific ways to do research in the arts, I have developed the project title from the original 'Symbioactive interactivity - productive reflection on perceptual breakdown situations in multi-modal, computer enabled environments' to 'Virtual Touch'. The latter title can be read as a special case of the first. The new title 'Virtual Touch' is an oxymoron like VR. If the virtual is to be understood as 'almost' (Sevaldson, 2005:119), then how can one be 'almost' touched? As will be discussed throughout the thesis, there are many qualitative dimensions to touch and there are many ways of touching, but the experience of it is 'digital' in the sense that it is experienced on or off. We rarely doubt if we are touched or not. The new title reflects a more specific dimension of my interest and work, but also the fascinating nature and possibilities of technologically mediated touch. One question then is: does it matter if I feel touch, whether it is digitally produced or convincing enough?

Originally the methods of research I planned to use were broader in nature. Narrowing down the focus of my research from the wide-ranging field of interactivity to touch in context with digital technologies has allowed me to write more specifically, in detail, and critically. A keyword for my

approach is *critically-informed practice*. This is research that involves a practical element—in my case an interactive media art installation—accompanied by an analytical commentary that sets the work in a theoretical, historical, cultural and critical context. A significant question to the notion of ‘*critically-informed practice*’ is to which degree the practice-based work is in itself the embodiment of theory, or just adding theory to practice (MacDonald, 2001). A critically-informed practice is a two way process. It requires that one questions ones practices in the light of critical theorizing and, in reciprocal fashion, to interrogate ones theoretical studies in light of practical experiences (Glanz, 2000:164), that is a ‘*practically-informed critique*’. This again relates to *critical reflection* which refers to a dynamic process of reflecting on practice that drives processes forward (Graeme, 2009:50).

2.2. THE PROBLEM OF PERSONAL INTEREST AND ETHICS

One of my biggest questions has been, and still is, how does one arrive at a systematic and thorough knowledge about issues one is personally engaged with? In my case I have been doing novel work on the interactive art scene. One example is my ‘Solve et Coagula’ installation showed at Ars Electronica in 1997 and presented at Siggraph in Orlando, 1998. None the less—or even because of this- I cannot, and will not claim I have an objective view of my field of problems. Due to the many international presentations and performances of my work involving touch, it is good reason to believe they have made a significant contribution to the development of touch as an expressive component and material in the field of interactivity, media art and possibly even man-machine perception. I am wary of how such claims make me protective and selective on how I present my work. When James Watson discovered the double helix (Kaiser, 2000:67), he later described his scientific undertaking more to be like a crime-story. His motivation was just as much about personal interest, winning, ego boosting as about acquiring ‘objective’ scientific knowledge. As an artist I am also ‘selling’ through a personal profile, a personal story, and not just objective knowledge, works of art or ‘pure’ experiences. I frame my projects with personal style and presentation. As with Watson such personal filtering of information tends to select more narrow views and informations that fit to the world view of the researcher. Having this in mind I believe it is still possible to arrive at a valid base of knowledge built upon a critical self-reflection. This ethics is perhaps more poetic and creative than a utilitarian ethics (Angrosino and Perez, 2000), especially if one understands ethics as a ‘manner of being’ according to Deleuze (Rajchman, 2000).

2.3. ON ARTISTIC PRACTICE AS RESEARCH AND METHOD

Making is thinking

– Richard Sennett (2008).

The problem of describing methodology in artistic research starts with the debate of how to do research in the arts. How does one systematically collect, organize and gain knowledge in the name of art? Before explaining the methods I used it is useful to explicate the frame for my own artistic investigations. First of all my own work is aimed at the production of actual works of art. In a wider perspective my research can therefore be considered as artistic and practice-based. My work has both a particular and a general perspective. The aim of this thesis has been to produce a particular work of art that articulates a particular experience, in my case touch within multisensory environments. In line with Sennett's statement and as a critically-informed practice, I hope the making of my practice-based experiment is reflected in my wordly thinking on and around this particular experience of touch. As stated previously, the aim of my research around such sensations in a general perspective is to provide a deeper understanding of touch in general and more specific in the context of art and technology. But how and when can art count as research? And what are the limitations as well as advantages of artistic research?

The history of artistic research is both short and long (Hannula, 2008). It is short in the sense that it hardly existed within the walls of European academia before the late 1980s. It is long in the sense that all artistic practice can be said to include practical research in finding out practical ways of how to make things. The inclusion of the third cycle, the Ph.D. equivalent level, in the European Bologna educational reform¹⁵ has given the discussion about artistic research new momentum. The problem of finding methodologies proper and productive for artistic research precedes this and starts with the debate about research in the arts and whether art and research can be brought together in a fruitful manner for both. One main question is how to both make good art and do good research? In the everyday production of art this appears to be an incommensurable divide. To my knowledge after attending conferences such as Senuous Knowledge 3 and 5¹⁶ as well as the ELIA research conference in Berlin in 2006¹⁷, very little of the best contemporary

¹⁵ Joint declaration of the European Ministers of Education, Bologna Declaration of 19 June 1999.

¹⁶ Organized by Bergen National Academy of Arts, www.khib.no, the conference web page is <http://sensuousknowledge.org/>

¹⁷ The conference report is found at http://www.elia-artschools.org/downloads/publications/research_conference.pdf accessed on April 1st 2010.

art has been the result of academic research. Research done from within the walls of educational institutions tends to stay there.

On the other hand, the production of art is an integral part of the artistic research process (Borgdorff, 2006). If artistic activity resulting in original creative works of art is labeled research then both the process and the end result are part of the research. Mixing personal artistic expressions with the production of knowledge certainly challenges our notions of the rigidity and scope of a science that includes objective research and impartial, intersubjective knowledge production (Kaiser, 2000:54). With the proximity in art between the researcher subject and artistic object, how does this influence our notion of what academic research is? Is it possible to produce valuable research on a more general level in the arts at all? Or even talk about research in the arts? There is a general conception amongst artists that the artwork itself embodies the knowledge of the artists practice and practical knowledge. The work of art is the result of –often- life long work processes where the artist has developed his very own style and epistemology of bodily attached expression. In line with Sennett’s quote above, it is as if practice demonstrates thinking, or, as Donald Schön says, it is as if competent practitioners know more than they can say (Schön, 1991). But is this notion of the form (or object) containing knowledge not a modern Pygmalion and Galatea story? That is an outdated romantic notion? The notion of art for art’s sake, the *l’art pour l’art* where the artist’s right to and privilege of self expression becomes the epistemological and teleological centre point? The next paragraph will take a closer look at the self-reflective and self-critical process of the artist producing meaning (Hannula, 2005:10). This could prove a better understanding of what at first glance appears to be a conservative romanticism.

2.3.1. What is artistic research

What is artistic research really? Does artistic production need to include research? Or, how can it not? If there is such a thing as artistic research, how does it differ from more formalized ‘proper’, academic research associated with science? And, does any open ended research as exemplified in artistic production get away from systematic categorization of knowledge? Even if there are different models of knowledge within art about art, there is still a legitimate need to ask where it comes from? Where is it now? And where does it want to go? As Sir Christopher Frayling says, artistic research should ‘*show awareness of the route map by which you reached the point you are describing. The technical phrase for this, we said, is research methods*’.¹⁸ Following the same line the Arts and Humanities Research Board in the UK

¹⁸ Christopher Frayling, Royal Academy of Art, London, http://vrc.rca.ac.uk/modules/articles/article.php?id_articles=2 accessed on April 3rd 2010.

only funds research that address clearly-articulated research questions or problems, set in a clear research context, and using appropriate research methods (Woodfield, 2004:103-8). So, as Henk Borgdorff extensively discuss in his article, 'The debate on research in the arts', when does art practice count as research (Borgdorff, 2006)? This is a key issue: what is the difference between art practice-in-itself and art practice-as-research? As in other research traditions there are many ways of thinking and practicing research. It is therefore useful to try to look at the different shades of artistic research. Frayling published in 1993 an interesting differentiation concerning how we can divide and subdivide the research done within the sphere or art. He came up with three different notions of artistic research: i) research into art, ii) research for art and iii) research through art. Borgdorff has developed this trichotomy with a slight twist into i) research ON the arts, ii) research FOR the arts and iii) research IN the arts (Borgdorff, 2006:11).

Research on the arts investigates art practice in all its variations and practices from a theoretical distance. Disciplines involved in this research are commonly art history and media studies. In research for the arts one finds the applied research where the goal is to refine, develop the way the artwork is produced. With research in the arts, or through as Frayling named it, the critical distance between the subject and the object in the research disappears. Theory and practice is here understood as the same, and again underpins Sennett's 'making is thinking' statement. The research process here produces art where knowledge is an embodied phenomenon articulated through both the creative process and the art object. It is WYSIWYG: '*what you see is what you get: works of art in a contemporary art show*' (Hannula, 2008). Frayling's and Borgdorff's triangulation of understanding artistic research has found a certain recognition within institutional thinking, but the notion of artistic research itself is still much discussed in the art world. It is hard to see the difference between great art and good research. Both appear to present new and communicable knowledge.¹⁹

Frayling's claim that the artistic researcher describes the route map of one's thinking does not appear to be too harsh, yet it does not explain the resistance against accepting formal research as a branch of legitimate art practice (Borgdorff). Pablo Picasso is quoted saying that '*Art is a lie that tells the truth*'. The statement points to the common notion of the improbability of artistic research. How can a lie become a part of how we understand, act and deal with 'reality'? Any 'objectivity' contained in artworks is based on the subjective and therefore non-objective view of the artist. Further it is, as Bourriaud's (2002) notion of relational art tells us, also context dependent. The arts are subject to the ever demanding strive for producing something

¹⁹ Christopher Frayling, <http://nelly.dmu.ac.uk/4dd/DDR4/ChrisF.html> accessed on April 3rd 2010.

new, something that has never been seen or done before. To quote Giorgio de Chirico, the object of new art '*is to create previously unknown sensations, to strip art of everything routine and accepted*' (Julius, 2002:32). This illustrates both the pressure put on every artist to create something new, as well as the art markets' high expectations towards new art bringing forth innovation. Why bother with formal academic processes when it is the art work that speaks for itself? Showing awareness of one's routemap is in most cases unnecessary for the end product of art practice-in-itself. Art in exhibitions appears commonly at 'face value' with little info about the process of creation. The difference between art practice-in-itself and art practice-as-research so seems context-oriented in that they target different frameworks.

The resistance against formal research procedures also stems from the practically and market proven fact that you don't need a Ph.D. in art to do great art (Borgdorff, 2006:9 and Lyons, 2006). A possible key to this conflict is seeing art as an open and process-oriented activity. According to Bennet, Foucault sees *Ars*, unlike *Scientia*, as promoting open ended inquiry; it can embrace the unknown, the abject, the amoral, the aberrant, the pornographic, not as pathology, but as experience (Michel Foucault, *The History of Sexuality*, vol 1, in Bennet, 2005:26). As the next section will discuss further, research provokes the impression of artists and the arts as being free and open.

2.3.2. Transgressive artistic research

The introduction of formal artistic research within the academic context is leading to the development of different cultures in the arts: research opens up a scientific-artistic culture (Hannula 2005). This is different from the market-artistic culture of the commercial art world as we know it from for example the Basel Art Fair, the various biennials like the Venice Biennale, as well as art galleries. Formalizing artistic research is seen as a provoking gesture to many artists doing tacit, practice-based research. Art practice appears to be in opposition to one of the core values of scientific research, that is to make the process and findings open and intersubjectively understandable. Scientific research is supposed to be repeatable as well as falsifiable, according to Popper (Popper, 2002:23), but artistic research appears unlike this. It has just as much to do with cultural, social and economic relations as with 'objective' findings. For something to be 'new and communicable' it does not necessarily have to be 'objective' or valid for all. Within the visual arts, the artistic knowledge is more often than not hidden behind a nebula of personal mythology focused around a charismatic figure (like Van Gogh, Picasso, Warhol etc) or a highly subjective worldview. The romantic notion is that a work of art should speak for itself. The understanding is often a 'why tell

why'? It is left to the critiques and art historians to analyze, contextualize and tell the 'true' story from behind the 'scenes'.

That art historically contains a certain transgressive dimension adds to the resistance to a 'scientific' production of art marked by clearly-articulated research questions or problems. This conflict is expressed in Art's historical potential to outrage or violate basic norms and sensibilities. Much art like Dadaism, surrealism and artists as Duchamp, Nitsch, Bacon, Koons and Hirst has wished to challenge and provoke established notions of art. They are some of many examples of art and artists who: *'have compulsively rejected received ideas in order to test and subvert morality, law, society, art itself'* (Julius, 2002). If transgression is a necessary element in innovative, novel and interesting art production, one could say that transgressive acts, action and thinking becomes a fundamental part of innovative artistic research. But how transgressive can research be? Before it becomes too solipsistic to be repeatable and falsifiable? An important aspect of all science and research is that it can be proven wrong. If not, then one is dealing with belief and religion, definitely not science. But how can art -as an individual expression- be wrong? If there is such a thing as artistic research it is perhaps more like the dialectics of Nietzsche's theory of becoming. Here there are no definite answers, but a flux where we seek to be and act in between concepts (Cazeaux, 2003:4). Likewise, avant-garde art tends to avoid a static view on art. According to the transgressive nature of art the artwork cannot be reduced to a product, but is found in the continuum of conceptual transition. Art -according to this view- is less about a finished product, but is always found in the transition between values, understanding and experiences. If we see this process-oriented understanding of art as one of the core values in art practice, this can also be taken as a metaphor of why artists resist research. Artistic practice seems to resist becoming what could be expressed as prisoners of static, conformist and according to this view therefore necessarily 'dead' works of art. Romantically speaking, in the words of Edward Munch, an artist's works are his children.²⁰ Such notions of art feed the understanding of it as something living, something that should be nurtured by care, contemplation, admiration and attention, and not some object to be dissected methodologically and scientifically. Romantic notions of art in combination with transgressive attitudes represent what can be called a 'warm' attitude. The 'warmth' is concerned with the tacit dimension of artistic production. It is not open to any understanding of art, and is certainly protective and full of discrimination against what can be called a 'cold' attitude towards art, that is the academic, methodological and analytical approach to the understanding of art most commonly associated with art

²⁰ Arne Eggum, 'Edvard Munch som maler', <http://www.munch.museum.no/content.aspx?id=15&mid=15>, accessed March 10th, 2010.

history. Within the 'warm' sector it is a much widespread notion of theory as something that is written after the artistic production. As Barnett Newman 'warmly' says (Gaut, 2005:xvii):

Aesthetics is for artists as ornithology is for the birds.

This much-cited quotation from the 1950s still represents the anti-intellectual stance towards art theory amongst practicing artists. Aesthetics is here understood as the prime domain of art history and theory. Such statements are also rooted in the artistic pride of discovering new knowledge through embodied practice. Artists, like Sennett says, think through that which they make. This, in relation to the nature of the artistic affection for transgressive values, seems to result in negative opinions towards what is conceived as an over-intellectualization associated with scientific practice. According to the romantic tradition art arises through discovery and creative practice and the impulse not to forget, in the Greek philosophy, through the inspiration of the *daimon*. In Yeats words: '*... for man and Daimon feed the hunger in one another's hearts*' (Hirsch, 2003:66). There exist many inspirations to the construction of art, many of whom like Yeats are enthused by the muses, that is, ideas come to the artist for some seemingly inexplicable reason. Art is something transgressive and inspired rather than routinised and homogenized as 'research' that in turn can be fed into the 'creative industries', the buzzword of this decade.

The romantic refusal to verbalize artistic knowledge somehow relates to the tacit dimension of artistic practice. Tacit knowledge is something we experience as embodied beings. Often we cannot say what it is that we know (Schön, 1983:49). We demonstrate knowledge while in action, in the making of the work of art, not through intellectual and disembodied approaches. This is what Schön terms knowing-in-action, another name for ordinary practical knowledge. When artists try to explain their creative process they feel at a loss, and often find themselves producing inappropriate explanations. We seem to know more than we can say (Schön, 1983:51). According to this art is a field continuously producing a knowledge in becoming. It is fleeting and hard to pin down as the relational product it is. One example is the theories of relational art by Bourriaud (2002) where artistic practice revolves around human relations and their social context. Here the conceptual dimension and art as communication practice adds a certain immaterial dimension to art. Schön is concerned about the more material dimension and describes how the tacit is important in the everyday production of objects. As *Homo Faber*²¹ humans in general and artists in particular personify a quite incredible

²¹ 'Man the Maker'

practical knowledge. Michael Polanyi, the inventor of the phrase ‘*tacit knowing*’ (Polanyi, 1998:96), gives as an example our ability to distinguish a person’s face among a thousand or even a million. We can tell the difference, but we cannot explain why. The concept of tacit knowledge is widely used to refer to all the knowledge that cannot be codified. It has, much like the personal experience of art, to be transferred through personal contact (Pozzali, 2008).

Another element arguing against formalized research in the art is a deeply rooted fear of a bureaucratization of arts practice (Hannula, 2005:12). Within practice-based professions where tacit knowledge reigns, the attitude is that the artwork should speak for itself. If it can, then why attempt to badly explain and possibly kill it with words? Hannah Arendt pointed toward this divide between theory and praxis as an artificial divide. She tried to develop a program to join the practical, working human with the thinking human (Sennett, 2008). Much like her student Richard Sennett she finds that the making generates thinking.

The transgressive stance and the adoration of tacit knowledge found amongst artists and reflected in their practical works clearly oppose attempts to establish a more formalized research as a legitimate part of art practice. At the same time the transgressive stance is futile. As Adorno formulates it:

Art revolts against its essential concepts while at the same time being inconceivable without them (in *Aesthetic Theory*, 1970; Julius, 2002:235).

In other words, there is no escape from conventions. Even the transgressive is a convention that within the avant-garde becomes normative. Revolting against concepts is in itself a concept. Artistic revolts often provoke, but they may also be seen as producing a kind of self-reflection in the artistic subject, both in the viewer and the artist. Challenging established notions of art can be seen as proposing new, radical hypotheses preparing for Kuhnian paradigm changes. Transgressive actions and behaviour can also be seen as a phenomenological break down of the instrumental use of art, much like Heidegger’s hammer example (section 5.4.5). Such break down promotes reflection. In turn this might lead the way for new knowledge. Can transgressive art then represent a valuable form of artistic research? If, as Adorno says, ‘*Every work of art is an uncommitted crime*’ (Adorno, 2005:111), then transgressive artistic practice in itself becomes interesting as a challenge to any notions of the artistic research process. But it is not just a matter of what or how art is produced. It is also a contextual question of where and how it is shown.

2.3.3. Contextual framing of artistic research

The huge and current debate of how artistic practice can count as research (Borgdorff) is an issue not just of artistic importance, but also touches upon and has consequences for fields like academic training, politics and market issues. However, it is also a question of context and where art takes place. If everything knowable is social (Bode & Schmidt, 2008:30) then artistic knowledge can be seen as a result of the complex contextual constructions happening in an art world consisting of several value systems. The contemporary research debate involves several actors and value systems, educational politics (Bologna reform) and strategies like the Scandinavian model (Hannula, 2008:111). It is also a challenge to the creative industries (Interartes, 2008:19) where the sectors of artist/cultural production, the public (non-profit) and the private (market-oriented) meet.

As the previous section shows, within the traditional debate about the autonomy of art, art is often seen as something to be as free from restraint as thought itself (Julius, 2002:224). This is an illusion in the complex social situations that frame art production and not to forget art education. As Maharaj says:

The art school and the art gallery-museum circuits add up to a star system in which the former is increasingly whittled down to a clearinghouse for the next crop of celebrities.... Today the star league figures almost as the *raison d'être* of art schooling (2004:45).

This statement points to several uncomfortable facts. One being that the artistic value of artistic research and production is set not just within the institutions, but also outside them and within the public and private sector. There is an intrinsic connection between these three sectors, and artistic research must take this complex interrelationship into account.

How has this affected my research? Throughout my working on Erotogod I have worked with both industry (Telenor), education (lecturing within art institutions), museums (Henie Onstad Art Centre) as well as public presentations and festivals (Ultima and DEAF). These cooperations have influenced my presentations to various degrees. One has been tilting the verbal presentation of the project towards a sensible and technological sound explanation. The actual experience of being inside the artistic installation, however, is targeting the individualized and abstract sensory experience.

2.3.4. Good research, crap art

Often we see the artist rather than the painting, whereas research is bigger than the researcher. - Lyons, 2006.

The notion of ‘crap art’ in research context was introduced during my presentation at the Sensuous Knowledge conference in Bergen 2008. This ‘crap’ heading made a point out of doing good research within an institution does not directly mean one makes good art for the art market. And making art that is deemed good by the market does not necessarily depend on good academic research. Often they seem to exclude each other. Why is there this split? In the tradition of confessional writing one can also ask how writing a Ph.D. influences the artistic work. Has my own art making become better due to the strict adherence to formalized, methodological processes? It is not always easy to see their connection, but it is an important question how formal procedures can advance practical outputs. In the making of artworks and in the tradition of transgressive art it is sometimes beneficial to put subjective reflection before intersubjective communication of thought. For the production of artworks it appears more important to do it, and less to argue why or how one did it. This can be held up against the process of writing a thesis which is a strenuous, hard, lonely and slow process that might as well keep the artist mentally and practically apart from doing practice-based works. As mentioned in relation to Watson, research is also not necessarily done for the artistic process, but also to gain a personal competence and position within academic communities (Kaiser, 2000:67). At the same time it is one of my many motivations to participate in the professionalization through academic practice and the curiosity to see where that leads my production. In the tradition of the Open Source community (Hannula, 2008:120) I have myself found great benefit from discovering and sharing new knowledge. A socially-oriented sharing of resources, as in the Arduino community²², means one does not have to reinvent the wheel every time one creates a media project. This counts for software development in particular and gives advantage to both thinking and making. But how does one assure not just speedy development, but also the best quality of research?

Why does it appear as if artistic research rarely if ever produces the same quality of art as art practice without formalized academic research. If the purpose of artistic research is to produce better art, then why burden artistic creativity with rigid thinking? And if it is so, what are the reasons for this? How can it be changed for the better? Why are the artists who enter artistic research often seen as second-class artists? Why is it that no artistic research

²² See www.arduino.cc homepage, accessed November 29th 2009.

project has ever made it to any big time art event? Spending three years on one project with more funding than most artists can dream of should potentially produce some amazing art works. Despite the more than thousand practice-based Ph.D.'s worldwide, and even more in the making, artistic research has not really made it very far outside academic contexts. One explanation for this could be that artistic research has been more about government funding of research into the practice of arts, i.e. art-historical and theoretical rather than being artistic and productive, that is in the arts. Artistic research therefore appears to be mostly about producing textual material, intellectual reflections, and knowledge about art, rather than making valuable, material and substantial manifestations of art. If artistic research produces less interesting art to market and audience-relevant art then such works can easily be termed 'crap' art. How can this discrepancy between works of art and artistic research be changed? How can one really assess the artistic quality of artistic research? Can there be good research without good works of art? How can we facilitate artists in conducting artistic research that produce valuable, important artistic expressions – without the artists becoming art historians?

The advantage of 'good' works of art that are perceived as relevant both to a larger audience, museums, and the art market is the amount of public debate it can cause. One example is Olafur Eliasson's *Weather project* at Tate Modern in 2004 which attracted worldwide attention for its spectacular transformation of the museum's enormous halls.²³ Here he built an artificial and immense 'sun' which radiated low frequent light that completely flooded and transformed the museum's vast turbine hall. As the project came about as a direct result of Eliasson interviewing the employees of Tate Modern, it has also been discussed in artistic academic contexts as an interesting example of artistic research (Hannula et al., 2005:130). If a work of art is not discussed, it is, in the words of Hannah Arendt, 'dead to the world' (Sennett, 2008).

One way to bridge the gap between written reflections about the work of art and the work of art itself is to stimulate the production of artworks. But how does one distinguish between what is good and 'crap' within the art academia itself? There is a certain protectionism and an intrinsic fear of artistic evaluation within art academia. It is a fear of failing to meet the merciless demands of the sectors of the public and the market. There are many reasons for this, one being the lack of marketing of artistic works-based on research, another the economic gap between private and public market. Therefore research on the arts still remains a phenomenon of the institutions. Another reason can be that the academic system is economically and partly socially set off from the other art world. To bridge this gap one element

²³ Tate Modern's webpage on the project is found at <http://www.tate.org.uk/modern/exhibitions/eliasson/about.htm> accessed April 2nd 2010.

would be to start seeing exhibiting and public response as a fundamental part of research. Acquiring a public audience was one of the goals of the Erotogod project. Two main reasons for this were both to get anonymous people interviewed as well as to receive a public critique and evaluation. For this reason the Erotogod project was shown three times, first at Henie Onstad Art Centre in Oslo, Norway, then at DEAF at V2, Rotterdam Amsterdam, and lastly at Atelier Nord, Oslo, Norway. The feedback I got from the many people I dressed, instructed and talked to was mainly verbal, but still important in assuring the quality of my research. Exposing my project to public critique was important, but felt risky nonetheless.

2.3.5. Risky research

The zone of safe academic research is apparently risk free compared to the more radical critique experienced in the open market. If we go along with Rainer Maria Rilke that:

Works of art are always the product of risk one has run, of an experience taken to its extreme limit, to the point where man can no longer go on (Birnbbaum, 2005),

then how does this fit in with academic research? The academic sector is, amongst other things, limited by state regulations, employment rights, and ethics not to mention social and political pressure. All in all there is much more freedom of expression to be found outside the academic context where, in the transgressive tradition, almost anything can function. This is a two way issue that –again- touches upon a highly charged problem encountered in the artistic research community; the artists wants to be completely free on the one hand and the research community needs a certain rigour on the other. It therefore appears as a problem to accept transgressive, conceptually provocative and individual projects as proper research. What if having no method could also be a method of artistic research? The standpoint of The Arts and Humanities Research Board is as mentioned (see section 2.3.1) to only fund research addressing clearly-articulated research questions, set in a clear research context and using appropriate research methods. This is a rigid view of research that might narrow their contribution to the production of better art. The decision of what is the better art is after all taken by a much more complex mechanism constituted by the amalgamation of museums, galleries, markets, critiques as well as audience reception. Without relating to such issues, institution-based artistic research will stay less relevant compared to the art world's massive production of avantgarde art products. After all it is a matter of definition of what is 'crap' art and what is not. In the tradition of relational art the definition of 'good' art is dependent on both

context and community. The role of the public also contributes to our perception of what is and is not art. Is the work of art interesting for the opinion of elites? Is it influential for the opinion of a wider audience? When I was working as head of exhibitions for the Norwegian Touring Exhibitions (Riksutstillinger, between 2003 and 2005) we mainly measured the success of an exhibition quantitatively in terms of i) attendance statistics and ii) the extent of press coverage for each exhibition. Good and successful art in this institutional context is measured in its quantitative social effect, that is: art is understood primarily as a social phenomenon relatively independent of style and material.

How can artistic research both be based on community and extremely individual expressions without stumbling into an aggressive spiral of Kuhnian paradigm changes? Henk Slager states that:

research conducted by artists is obviously not characterized by an objective, empirical approach, since art indeed does not strive for generalization, repeatability, and quantification. Rather, artistic research is directed towards unique, particular, local knowledge.²⁴

Further, in the text to the exhibition ‘Nameless Science’, Slager states that artistic research ‘*leads to novel artistic strategies and intensities of perception*’.²⁵ This particularisation means that artistic research is not excluded from being science proper, but it does pose a challenge to our notion of quality, our methods of assessment, as well as the normative ethics of academic streamline thinking.

There are several reasons why artistic research should be more interesting to the artistic community. It happens in the relatively protected atmosphere of the academic laboratory, which enables exploration, reflection and production with relative ease, focus and access to resources. The National Norwegian Artistic Research Fellowships Program is one example of this. In my own work I have also benefited from this programme and from an initial scholarship from Telenor R&D. But perhaps parts of the ‘crap art’ problem lies here as long as the real epistemological lab of art is found in the exhibition context, that is in the zone of friction between the live visitor, the context-based venue, the physical artwork, the scrutinizing gaze of the public and the merciless critique of media.

Another issue is the artistic research field’s lack of critical mass. This relatively young field is too small, too fragmented, too lightweight, and has too little power of definition to compete with the traditional qualitative

²⁴ In www.lierboog.dds.nl/workshop.doc accessed on March 10th 2010.

²⁵ <http://apexart.org/exhibitions/slager.htm> accessed on November 29th 2009.

filtering that the established commercial art world is so good at doing. It is however an activity in the making. The challenge for a rapidly growing field is to accept that not all art projects fit within academic research traditions. Also, in a field where few things are right, some projects might need both breathing space and the opportunity to fail better. An abundance of methodological approaches is required to achieve this.

2.3.6. Abundance of artistic methodologies

How does one systematically collect, organize, gain and distribute knowledge in the name of art? When is rigorous academic thinking the way to go for artists and their work? Feyerabend in his book *'Against Method'* (1975) argues that the world is so diverse, chaotic and surprising that there cannot be one method (Hannula, 2005:38). Concepts like 'truth', 'reality' or 'objectivity' narrows people's vision and ways of being in the world. Therefore it is possible to argue in favor of methodological anarchy and tolerance (ibid). This involves a methodological and research-based experimentation, pluralism and tolerance. Is this what distinguishes artistic research from the more rigid methods of universities? Hannula et al propose a democracy of experiences to overcome the constructed differences between artistic and scholarly research. Here no experience is cast aside, no experience has a higher status due to its origin or reputation (Hannula, 2008:113). This focuses on the important role of experience as the foundation of new knowledge. Hannula et al argue (Hannula, 2005:37) that in the case of artistic research methodological abundance is a specifically productive approach. Does then anything go? Still it has to be an open-ended, self critical and reflective process. Yet, *'the information produced by artistic work has been the underdog in relation to scientific expertise and the truth produced by it.'* (ibid, 2005:34). But this is not the result of wrong methods, but perhaps more an effect of the relatively short history of artistic research and distribution of the artistic knowledge contained herein.

As mentioned before, there is arguably less difference between artistic and academic research than is commonly thought. According to Borgdorff (p. 8), science at its best is less rigid and less constrained than many of the participants in this heated debate would like to believe. Scientific research is marked by openness and self-criticism (Hannula, 2005:26). Many consequences could be drawn from this. As in the case of the Norwegian scholarship program (see next section), one is to further the close connection between producing works of art and producing valid artistic research methods. If not anything, then a correlation can be more fruitful than one would think at first glance.

Attempts to distinguish visual art practice from academic knowledge practices and expertise (Bode & Schmidt, 2008:27) try to set apart the

artwork from the theorizing around it (James Elkins 2005, in Bode & Schmidt, 2008:27). It is as if art and artistic research are like ‘*two incapacitated cargo ships set on collision course*’. In the light of how both artists and visitors approach and try to understand art, this appears as an unjustly constructed difference. As Bode & Schmidt (2008) observe, the default position of anyone going to a gallery is trying to observe and understand the artworks just as the researcher who follows a hypothetic-deductive and qualitative methods. This implies that any member of an audience applies his or hers own unarticulated and implicitly tacit method in the mentioned setting of a gallery. The methodological consequence is here that it becomes manifold, pluralistic and abundant. At the same time the goals of such tacit artistic research methods are perhaps not necessarily so unlike the ones found within the academic tradition. However, if such approaches are to be formalised, they must also be able to answer critical questions and reflections.

2.3.7. Critical creative production

Research appears to be fundamentally important to enable, inspire and motivate artists to produce works they would otherwise not be able to do. This is reflected in The National Norwegian Artistic Research Fellowships Program, which concentrates on ‘*artistic practice as the focal point of candidates’ projects*’.²⁶ The candidate must also write a critical reflection, but the main emphasis is on the artistic project that must be an ‘*independent work of art at a high international level with respect to originality, expression, consistency, relevance, presentation and communication. The work shall contribute to the development of new insight, knowledge and/or experience.*’ In short this practical view of seeing artistic research as producing artworks is meant to stimulate the production of art. Hence one answer to the question of why there should be academic research in the arts is that it presents an opportunity not found outside the institution.

Until recently it was almost impossible to do a Ph.D. degree in the context of art academies and arts training. The current higher education reform in Europe is now introducing the Ph.D. as its third cycle after the first bachelor and second master degree. This move opens up new resources and new possibilities in the field. As discussed on ‘wicked problems’ in section 1.5.2, it is perhaps time to open the window and jump out (Hannula, 2005:13).

At the School of Architecture and Design in Oslo, AHO, its approach to research is that its disciplines are built upon practice as the most important source of new knowledge.²⁷ Hence the term ‘*making disciplines*’ is used to

²⁶ <http://www.kunststipendiat.no/en> accessed on November 29th 2009.

²⁷ Available in Norwegian only <http://www.aho.no/no/FoU/Forskning/Forskningsstrategi/>. For information in English visit <http://www.aho.no/en/RD/Research-at-AHO/> accessed on April 10th 2010.

cover art-, architectural- and design-based research (Dunin-Woyseth and Michl, 2001). Development of new knowledge is done through the iterative development of specific projects, also known as ‘*research by design*’ (Sevaldson, 2008; van Turnhout, Terken and Eggen in Andr , 2008:261). This can also have the character of artistic practice targeting the making of artworks. Both the Artistic Research Fellowships Program and AHO here share a common understanding of the important role of practice-based research.

The challenge that artistic research presents is that interesting works of art could be produced independently of the traditional context of museums, biennials and galleries. This poses a risk to the established system, but could just as well be seen as a positive expansion and addition to the wider artistic field. It is time to demystify artistic research of the kind undertaken for a Ph.D. and to emphasise what it represents: a critical knowledge of the research methods appropriate to the field of study achieved through critical practice, that is a critical and creative production. As Frayling, says the Ph.D. is training for research, as well as a demonstration of successful achievement in research. The University of Northampton developed practice-led Ph.D.’s ‘*from the premise that critically-informed practice can be a valuable, lucid form of research*’.²⁸ This opens up the production of interesting artworks as a welcome part of future academic practice. As the next section describes, finding my methods has been a process of constructing mutually supportive academic and artistic practice.

2.4. FINDING MY METHODS

The use of methods in practice-based art research is nothing mysterious. The context of critical practice is about exactly that: practical matters, not speculative metaphysics. Methods are simply tools to think and work with. Without methods systematic thinking is difficult. Methods describe how the scientific results are found, and how it is possible to recreate them. They function as navigational instruments that guide us to new knowledge. With no description of the methods used it is also hard for others to intersubjectively know how the results and conclusions were reached. The Millennium courses²⁹ have formed the core of my Ph.D. training. Since day one at the introductory seminars in 1999 at the Oslo School of Architecture, the participants have been schooled in theory, methodology and critical thinking in the making disciplines. Therefore, already in the beginning of my

²⁸ The University of Northampton, <http://www2.northampton.ac.uk/portal/page/portal/Arts/home/research/pgrad/practiceledphds>, accessed on 24th of July 2009.

²⁹ Organized as a Scandinavian Ph.D. training course by The Oslo School of Architecture and Design - Norway, KTH - Sweden, The School of Architecture in Aarhus – Denmark, and UIAH –Finland.

Ph.D. studies, I was given the opportunity to gradually focus in on different methods that were interesting and practical in relation to my research issues.

Qualitative research can be described as a complex field of different interpretive practices that attempt to understand parts of the world, without the belief in an 'objective' reality. Here, the understanding of touch is a matter of understanding the user and their position in the world. The focus of my thesis is specifically on virtual touch as *experienced reality*³⁰ within computer-based and computer-created 'worlds'. This is a user-oriented kind of experience where one major challenge is to understand the human component. Such a qualitative approach therefore appears more suitable to help understand experiential-sensuous states. My methodological choice is consequently of a qualitative kind, applying qualitative research methods using my artwork as a special case. This focus on the experiential and qualitative dimension does not exclude the indirect use of quantitative methods in my research process. My use of numerical statistics to understand the results of interviews is an example of that. As in much artistic research several methods are combined and intertwined to adapt to real life situations.

2.5. THE BRICOLAGE OF METHODS

Bricolage is thinking while doing, thinking as doing.

- Richard Sennett

How to scientifically approach the complexities of everyday life as humans live it? Michel de Certeau (1988) proposes that everyday practice is the '*investigation of ways in which users operate, (...) necessary to articulate everyday life*'. Qualitative research offers multiple perspectives and approaches to science as a producer of knowledge. Its overall focus can be traced back to the historical roots of the Chicago school in the 1920s and 1930s (Denzin and Lincoln, 2000). With its sociological and anthropological interest qualitative research was about everything human. As Vidich and Lyman writes (Vidich and Lyman, 2000), it was '*born out of concern to understand the other*'. Here is an important self-critical moment; because how does one understand the other without understanding oneself? Or even 'the self'? This question highlights the importance of awareness of self-reflection in qualitative research. It is '*a situated activity that locates the observer in the world*' (Denzin and Lincoln, 2000). As qualitative research has expanded it has included a wide variety of traditions and new epistemological perspectives. These range from positivism to post-positivism, modernism to post-structuralism and post-modernism, up to the

³⁰ This is a similar to the general focus of Dag Svanæs (2000:115), but differs in the research target.

variety of new, interpretive, qualitative perspectives of hermeneutics, structuralism, semiotics, phenomenology, cultural studies and feminism (Denzin and Lincoln, 2000:3). The complex range of traditions, perspectives and approaches has led to a 'blurring of the genres', calling for a multi-faceted approach to scientific investigation (Janesick, 2000). This has led to the concept of the researcher being a '*bricoleur*'; someone who in the words of Levi-Strauss (1966) is a '*Jack of all trades*'. Practically speaking it means that adaptive methods are necessary for a changing field of study. The bricoleur makes a 'bricolage'; a combinatory, pieced together 'carpet' or cluster of methods and approaches that fit to the complexity of the research field. She or he is pragmatic and adaptive, acknowledging that research is an interpretive practice revolving around interactive situations coloured by culture and Zeitgeist. Research is a practical and creative work. In line with C. Wright Mills, intellectual activity can in itself be understood as a kind of craftsmanship (Weiland 1996:6). Simplified, one consequence of this perspective is that 'objective' reality –if one acknowledges this notion of reality- can never be captured. We construct how we perceive reality, but we do not construct reality itself. Our notion of science is founded in a culture undergoing a continuous change. Even if we believed in 'reality' today, our cultural concept of it is virtual: it can and will change tomorrow. However, this does not mean 'anything goes'. As science, qualitative research is about the systematic, methodological construction of knowledge in all its complex and contextual, but functional relations (Cupchik, 2001). As the qualitative research offers no distinct method of its own I have investigated different bricolages of approaches on my way to a pragmatic combination useful for my research.

One inspiration is how artists take action in the world. The works of graffiti artist Banksy (2006) is created through action in the form of tagging or trespassing on public property. Likewise the artistic method often consists of interventions in the world. The method of *Action Research* has a similar approach (Greenwood and Levin in Denzin and Lincoln, 2000:94), if not as shocking. It does not represent one exact approach, but covers a family of research methodologies facilitating for change or understanding by pursuing action and research at the same time. It usually happens as a cyclical process alternating between action and critical reflection. Through the improvement and refinement of methods, data and interpretation an increased understanding gradually emerges (Dick, 1999). The goal of action research is that the action and the research mutually enhance each other. One of several criticism raised against action research is that it confuses social activism and development with research. Such and other possibly hidden political agendas are reasons why critical reflection is a crucial component of action-based research.

Other inspirations to this research are the many different interactive media-art installations I have seen and experienced. Another relevant approach to my research interests would be to do either a single or multiple case design study (Yin, 1994) (Stake, 2000)-based on these experiences. Even if *case study* strictly speaking primarily is about what case is to be studied (Stake, 2000), the case study *research method* can be described as an empirical inquiry that investigates a (contemporary) phenomenon within its real-life context. This is applicable especially when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used (Yin, 1984:23). One criticism of the method of case study is that the study of a small number of cases cannot offer grounds for establishing reliability or generality of findings. Also, such intense study of (single) cases is likely to cause biases. If one is to propose a generality of findings based on a small number of case studies, this becomes an ethical issue. However, a series of in-depth case studies can be very revealing without necessarily being indicative of something 'objective'. My main reason for extending the methodology of classical case studies and including research on my own experiment is that it gives me a better control over the parameters in the events to be studied. Therefore it presents the possibility of conducting a more classical and controlled experiment (Yin, 1994:9). None of the interactive experiments I encountered at the outset of my thesis had the sufficient complexity or multimodal interface technologies that was relevant for the working hypothesis on touch as described in chapter one. It was therefore necessary to go a step further, expand on the 'classical method' and attempt to use one of my own experiments as 'case study'. I therefore use my own work as a series of case studies, but concentrate on one project in particular, namely the Erotogod project (chapter six). All in all this therefore represents not just a qualitative but also an autoethnographic approach to the issues of touch and experience.

2.5.1. Autoethnographic methodology

The main focus of this research is on my own process of making and testing interactive installations and bodysuits. From my position as a practicing artist I have a unique possibility to 'report from the inside' and describe my thinking and doing. I am in possession of tacit knowledge (Polanyi, 1967) or Schön's '*Knowing-in-action*' and through my projects I am in position of telling my own story. According to Ellis and Bochner, the field of autoethnography is an autobiographical strand of writing and research (in Denzin and Lincoln, 2000:739). Within its complex layers it connects the personal to the cultural. It is composed from within a simultaneously personal and social space. The distinctions between the personal and cultural become blurred (ibid p. 739) and the author/researcher is no longer an objective

outsider in his/her writings. An example of autoethnographic research is Kathleen Stewart's book 'Ordinary affects'. Here she calls the book an experiment '*committed to speculation, curiosity, and the concrete*'... '*trying to provoke attention to the forces that come into view as habit or shock, resonance or impact*' (Stewart, 2007:3).

Advocates of autoethnographic methods argue that to understand others one should understand the self (Harold and Stephenson, 2006). This statement in itself shows how difficult it is to precisely define and apply autoethnography (Ellis and Bochner in Denzin and Lincoln, 2000:739). How do I reveal myself to myself? As writings appear as the common working material/output of autoethnographic research, one goal is to go through a process of writing that reveals what happened in my experience with myself or within situations I caused. In short, it is about writing stories about realities. How does this as a method differ from writing fiction? It differs in that it tries to portray what actually happened, or at least by not telling something that one knows to be false (ibid, p.753). By setting the living, personal experience in a context and analyzing it, autoethnography makes it possible to learn about the general from the specific (Harold and Stephenson, 2006). If the self-reflective process is thorough enough, possibly the result will speak beyond itself.

For me personally, the autoethnography method has inspired my self-reflection and analysis through setting my lived experiences in context. Relevant for the topic of the thesis is: which meaning does the embodied experience of touch assume in the context of lived experience? To uncover this I have based the research on the following data collection:

- *Participant observation* of behavior in the installation environment. These observations were recorded as field texts, through free writing, self-introspection and stories.
- *Document analysis* of video of the participants inside the installation.
- *Reflective writing* to reflect my personal experience of the professional practice approach.
- *Discussions* with critical friends to explore emerging issues in depth. This was done, for example, during a presentation at Atelier Nord, Oslo in 2003.

Underlining the self reflection and subject-oriented experiences are methodological similarities between autoethnographical methodology and empirical phenomenology. Empirical phenomenology is known to focus mainly on the researcher's self-reflection on experiences of the phenomenon

under study, and to the participants' (the subjects) descriptions of their experiences (Hein and Austin, 2001).

Both methodologies represent uncertain research processes that are exposed to several sources of error and erroring on behalf of the subject writing it. Such methodologies are also vulnerable to the self referentiality and circular interpretation of the hermeneutical circle (Patton, 2002:497). Even if the meaning of a text must here be found within its cultural, historical, and conceptual context, it is still criticized for being signs referring to other signs. And why do not these signs refer to yet other signs – where in the end there is no ultimate meaning or concept. Inspired by the autoethnographic method to speak through my own voice and experience, it is also my intention to move on. To overcome the deadlock of overt introversion present in such introspective endeavors, it becomes all the more challenging to develop a method that fits my work and my particular kind of research.

2.6. THE CHALLENGE OF METHODOLOGICAL DEVELOPMENT

The project aims not just at generating empirical knowledge, but also at developing new designs for the scientific quest within the aesthetic field - and in particular in relation to new media. Why is this so important? In the case of art and interactivity, contemporary theoretical understandings of (Laurel, 1993; Druckrey, 1997; Stone, 1996) are based on unlike experiences of computer-enabled environments. We do not yet have a common conceptual understanding for the experience within touch-based interactive systems. A central challenge to the project has therefore been to develop convincing approaches and ways of conducting scientific research in the field.

Throughout the Millennium course at AHO it became clear that the greatest challenge presented to reflective practitioners is to develop efficient and new combinations of scientific methods appropriate for the practical-aesthetical field. Without any established and obvious research strategy to fall back upon, the current pluralistic, hybrid research method has evolved. Another inspiration is Habermas' model of the three scientific interests. Habermas constructs the definitions of worthwhile knowledge and modes of understanding around three cognitive interests: 1: prediction and control, 2: understanding and interpretation, 3: emancipation and freedom (Cohen, 2000:29). Firstly as chapter three, four and five explain, I have developed further a technical understanding of what touch is and can be, secondly -in chapter five- a theoretical framework for the understanding of it, and lastly chapter seven and eight look at emancipatory uses of the results of the thesis. Of fundamental importance is the hermeneutical dimension of understanding the phenomenon. Even if Habermas's model provides a nice way of framing

a problem, it has been criticized for lacking a fourth pillar: the expressive interest. Such existential dimensions present critical elements in the evaluation of the user interviews.

On the background of pragmatic choice, a more traditional way of research was chosen for my perhaps more unconventional experiment. In addition to the empirical and practice-based research experiment, the traditional scientific and social science methodologies of user observation and questionnaire were chosen. These are all recognized and established ways of doing research.

The three methodological cornerstones of my scientific research process are: empirical practice-based research, user interviews, and user observation. Combined with the practical experiment and the autoethnographic approach, my research methods can be described as ‘hybrid’, drawing on interdisciplinary research. This reflects the central challenge that faces the practical-aesthetical research field: how to develop methodologies that i) pay justice to and ii) are applicable to the individual –even evasive- character of artistic cases. With a personal and qualitative approach, how to secure my research against alternative, conflicting understanding and avoid wishful thinking? The three cornerstones of my method consist of a triangulation that is relating results of different experiments to corroborate or support each other. This provides mechanisms and measurements contributing to make artistic research qualitatively sound.

2.7. EROTOGOD – A PERSONAL, PRACTICE-BASED ARTISTIC EXPERIMENT AS CASE STUDY

Practiced-based research is research formed by the practice of making art (Graham, 1997:15). Such art-led research is integrated in this thesis through the construction of a practical-aesthetical experiment. This represents empirical research by the testing of a prototype of a touch-based and interactive installation. The advantages of building a prototype are many (Stary, 1996). First of all it facilitates testing conditions that are not covered by established principles of design. Then it provides an evaluation of a first concept for user interface as well as giving quick feedback from the user(s). Drawbacks include the temporary and limited experiential construction of prototypes. The scope of the first Erotogod prototype was to cover certain aspects of technologically produced touch. As an experiment it has an open, explorative character. Through the empirical study of multimodal interface technologies in computer enabled environments the four hypotheses stated in chapter one will be evaluated in chapter eight.

For my empirical investigation I designed and developed the ‘Erotogod’ project that was exhibited at the Henie Onstad Art Centre in October 2001 (chapter six). The multisensory, immersive and touch-based computer

enabled environment of Erotogod was constructed on the basis of my earlier interactive media art installations such as *cyberSM* and *Solve et Coagula* (chapter four). According to Schön, artistic works can be seen to represent knowledge, and the way the artist makes them reflects artistic methods (1983). In the future and within a new framework of building systematic knowledge, making artworks could possibly be part of building methods. In the case of multifaceted works of art like mine a pluralistic combination of the research methods can prove useful, hence the naming of hybrid methodology to describe my artistic research process.

2.8. SUMMARY AND DISCUSSION

A sturdy methodology is essential to the development of a critically-informed practice. This involves positioning oneself in relation to the field of research. The chapter is therefore divided into two parts. The first half looks at the wider field of artistic research and comments on the challenge of doing artistic research. It attempts to frame the questions of methodology and knowledge production within the current debate about practice-based research. It asks important questions on the relation between art and research as well as the nature of the knowledge generated by artistic research. The differences between art practice-in-itself and art practice-as-research are also discussed.

The second part of the chapter describes my form of artistic research and is a route map of the methods applied during my practical art experiment 'Erotogod'. This section presents how my practical art work becomes 'art-as-research'. In parts my research appears as an autoethnographic study of my experience of touch, and of the process of making and testing of bodysuits.

The methods chosen to be used were i) empirical practice-based research, ii) user interviews and iii) user observation. These were applied as tools to systematically create knowledge relevant to the making disciplines. The complex and multifaceted character of practical-aesthetical experiments demands bricolaged and interdisciplinary methods, therefore the use of 'hybrid methodology' is suitable to describe my research.

Methodologies of art promise to be used to define new practices of human social inquiry (Finley in Denzin, 2005:684). For many the combination of free artistic practice with formal research appears as a contradiction in terms. In the right context, with the appropriate and consequent methodologies, art can count as good research. Practice-based art appears to contribute to how new stories and amalgamations widen the way we know and what we know. One advantage of artistic research is its focus on subjective knowledge in the form of individual expressions. The challenges are, however, many, ranging from the ethical as in Banksy's works, to the market-driven factors where sales numbers can appear to decide what is good or not.

One main question posed in this chapter is whether there are similar ways of constructing knowledge systems within both art and science. Is artistic knowledge worth the same as the knowledge we derive from the hard sciences? Or less? To answer this chapter six and seven will go into detail about the project that serves as the practical example in relation both to the exploration of touch and in the development of a critically-informed practice.

The next chapter will look at how touch functions from a physiological point of view, how it is psychologically perceived, and how it phenomenological contributes to the making of meaning.

3. THE PHYSIOLOGY, PSYCHOLOGY AND PHENOMENOLOGY OF TOUCH

The deepest thing in man is the skin. - Paul Valéry³¹

The initial question of this thesis concerns the manner in which touch is technologically reproduced and experienced. But, what is touch in itself? How does the sensation of touch come about? This chapter explores how touch functions. Is it a distinct feeling of its own? How does it relate to the things that are external to the body? Or are the body and the world inextricable aspects of the same unitary experience? On the physical level of skin functionality, how is the skin touchable? What makes skin register touch? And, in the larger picture, how do the diverse haptic senses function together?

To elucidate these questions in order to understand touch, the following chapter will look at how we corporeally register, psychologically process and phenomenologically reflect upon touch. The domains discussed -body, mind and experience- comprise a range of physiological (biological), psychological (mental) as well as cultural issues.

Designing an interactive media system like my Erotogod experiment (chapter six), which is based on the manipulation of user perception presupposes that the artist has a working model of human perception. The theories of perception presented here will therefore serve as doorways to the understanding of touch.

Experience from my own projects shows that the design of meaningful haptic content and communication is dependent on several factors. One is knowledge of how the skin functions and how tactile information is encoded, transmitted and processed (Pasquero, 2006:6). Designing for haptics is a broad field that involves physiological, mental and psychological aspects. In

³¹ in Ewing, 1994:138.

addition to these, the experience of touch, that is its phenomenology, is central to the understanding of haptic sensations.

The first part of this chapter discusses the physiological underlying mechanisms of touch, explains how the physical mechanisms behind corporeal touch occur and how we neurologically perceive touch. The second part investigates the psychology of touch, looking into the mechanisms of how touch is perceived. How we understand touch outside its somatosensory dimension (i.e. the biology of sensory receptors) is seen in relation to its emotional and mental construction and contextualization. This involves the cognition of touch: how do we know that this touch is hard, sharp, pointy, warm, soft, good, etc.

This leads thirdly into a phenomenology of touch exploring the experience of touch, how the meaning of touch arises and how it casts light on the general way we are embodied and ‘find ourselves in a world’ (Ratcliffe, 2008:299). Metaphorically speaking, the three approaches to touch follow it cumulatively from the skin to the brain and back into the world.

Understanding the multifaceted aspects of touch has been important for the construction of instrumental touch technologies as exemplified in my various bodysuits, (see chapters three and six). In the context of this text the sensory characteristics of the skin will be considered from an artistic perspective. Understanding the basic functionality of touch is a way to use and apply touch, enabling the artist to craft the better stories and create stronger media-based artworks. As history relates, this is not always a straightforward procedure.

3.1. EARLY HISTORY OF THE SENSES OF TOUCH

The history of touch starts with the history of the five senses. These have been much discussed within the history of perception. The intention here is not to comprehensively cover the topic, but to give an overview of some of the early discussion of touch. Dividing the sensorium –as the sum of all senses- into five has established itself as the most common historical division, dating back to Indian medicine and philosophy as it appears in the Vedas. Here we encounter for the first time the idea that perception or sensations are localized to specific organs (Jütte, 2005:20). Better known to Western philosophy is Aristotle’s establishment of his theory of the five senses in *De Anima* (ca. 350 B.C.) where sight is considered the superior sense (Paterson, 2007:1). Although he places touch as the lowest and most physical sense Aristotle has a central position and made one of the most substantial contributions to the history of trying to understand how touch specifically functions.

While Plato discredits the senses as being illusory and deceptive, Aristotle sees the description of the senses as essential to understanding biology and ultimately human and non-human perception (Paterson, 2007:16). In his study of the senses he puts touch in the centre. It is both indispensable and prior to the other sense modalities. Even if sight is to him the supreme sense and the ultimate perfection of sensoriality, he considers touch as fundamental to living. It is ‘the deprivation of this sense alone that leads to death in animals’, (Aristotle, *De Anima*: 220).

Recent research has shown how important touch is for the development of the human personality as a whole (Field, 2003:1). Aristotle’s view of touch as independent of a single organ is breaking away from the thought that perception belongs to a specific organ. Where the eye is for seeing and the tongue for tasting, the sensation of touch is dependent on the *flesh as a medium rather than an organ* (Paterson, 2007:17). Aristotle’s idea that touch is not attached to a physical organ is first discussed by Plato in *Timaeus* (Jütte, 2005:35). An interesting aspect of not belonging to a specific organ is the holistic function touch then receives (Plato, *Timaeus*, p. 56). Bodily sensations like pleasure and pain, heat, cold, smooth, rough, edgy and round are all ‘disturbances that affect the whole body in a common way’ (Timaeus, 65c, referenced in Jütte, 2005:35). This understanding of touch puts it in a larger context, and relates it to Plato’s theory of the senses. This is also visible in Plato’s philosophy of ideas, the word ‘idea’ stems from *eidōs* which means ‘to see’ (Jütte, 2005:36). The new approach in Aristotle’s philosophy is that he ‘ascribes psychical functions to the senses’ (ibid, p.36). Even though he thinks the heart to be the organ of touch (ibid, p. 42), touch is no longer just some separate physical entity on its own, but –as he says about sensory deprivation above- affects no less than the whole organism. Yet, the sense of touch appears both on the top and bottom of Aristotle’s five point scale of the hierarchy of the senses (in addition to sight, hearing, smell and taste). This apparent contradiction was further treated by scholars like Avicenna and Aquinas who tried to develop theories that reconcile touch and sight as equally important (ibid, p. 69).

Early modern theories on tactility followed up on this idea. The English physician Crooke describes touch in 1615 as something that is dispersed throughout the body (Harvey, 2003:82). It cannot be pinned to a certain organ or function. It is immediate in the sense that there is no medium between the body and the world that produces the touch. It is dispersed throughout the body. Carla Mazzio has done a very interesting analysis of Thomas Tomkins’s 17th century play *Lingua* (also in Classen, 1993:4). In this drama about the social sensorium, touch is presented as such a distributed phenomenon. In the play *Tactus* (touch) is one of the protagonists, and through his ‘resistance to representation’ and ‘*polymorphous diversity*’ he

claims that every sense is a kind of touch (Mazzio, 2005:88). This poses an intriguing question: what would be the consequences of a reduction of the sensorium to different kinds of touch only? What would then ‘music to the ear’ and ‘painting to the eye’ be (Howes, 2005:56)? Such a reduction quickly makes it obvious that touch is not just hard to categorize, but also impossible to pin down. Tactus only excludes the possibility to differentiate between various sensuous impressions and soon reduces the impressions on the sensorium to a grey and messy matter. There would be no arts, no differentiation between beautiful and ugly. As our everyday experience tells us, this cannot be and the play therefore soon restores the hierarchy of the senses. This indicates that there is a deep interrelation between the different senses. Such a cross-modal interaction seems to overcome the perceptual limitations of each sense has by itself. This phenomenon of synaesthesia will be explored further in chapter six (section 6.2.2).

The history of touch includes the tendency to objectify it. The question is not just what touch is, but how it can be formed and what it can be formed to become over time. The senses seem not to be static entities, but appear to transform themselves in relation to socio-cultural changes. Karl Marx said that ‘*the forming of the five senses is a labour of the entire history of the world down to the present*’ (Classen, 1993:7 and Jütte, 2005:10). If this is the case, then the notion of the five senses is a plastic and cultural construct that changes over time.

Whereas the senses of sight and hearing can be observed, measured and somehow objectified through various recordings like video and audio records, touch resists similar kinds of objectification. It remains until today something immediate, fleeting, subjective, deeply personal and impossible to reproduce and share with others. As Mazzio says, the history of touch is a history of the rejection of objectification (Howes, 2005:86). Constance Classen has a similar perception, saying that the history of touch is as difficult to define as touch itself (Classen, 2005:3). Her approach to touch is through the looking glass of culture.

An interesting approach to the history of touch is all its hidden histories revealed in Mark Paterson’s ‘*The Senses of Touch*’ (2007). Here he notes how the history of the non-visual senses has been ‘actively forgotten, deliberately written out of the history of the West’ (Paterson, 2007:59). In his critique of ‘visualism’ (ibid), he tries to ‘*reveal the underlying haptic aspects of spatial experience and reinscribe them into (...) cultural history*’ (ibid, p. 59). Referring to the complexity of sensory information and the somatosensory system, he argues for the multisensorial aspects of spatial experiences.

Following Marx’s historical and philosophical transformation of how we understand touch by taking the discussion out of a medical context into the

social domain, Jütte states *'there can be no such thing as a natural history of the senses, only a social history of human sense perception'* (Jütte, 2005:9). Touch it seems, is indeed a part of Merleau-Ponty's intentional arc, that tight connection between body and world (see section 1.1), and subject to individual perceptions. Does that mean that it can never be objectified and that it is impossible to establish a common, strong ground for the utilization of, for example, a haptic language?

Aristotle's classical division of the sensorium into the five senses is a construction that has shaped the history of perception. It has been challenged by psychologists such as Sherrington and J. J. Gibson (Paterson, 2005:20). Contemporary understanding of the human senses has changed and its number currently ranges from eight to twenty-one (Durie, 2005). The number is not so certain now because of continuous discoveries in neuroscience. There could be less or even more. As our senses seem to work across modes of functionality, it is most likely not possible, or not even sensible to pinpoint the exact number of senses. Our understanding of the senses in general is still only partial and its debate a long way from being finished.

Touch is more often than not treated as a specific sense, but as a term it is more a conceptual umbrella covering a wide field of experiences, sensations and phenomena. It is a very diverse phenomenon covering experiences from chewing to social contacts to inner body movement. Therefore it is more descriptive to talk in plural of the senses of touch than touch in a singular form. This thesis will focus on the haptic dimension with special focus on the tactile sensation of pressures. So how does one understand touch today? How do we functionally perceive touch? The development of theories of touch will continue in chapter five and the next section will try to explain how it physiologically comes about.

3.2. THE PHYSIOLOGY OF TOUCH:

UNDERSTANDING TACTILE INFORMATION

Every day of our life we collect and process an immense amount of sense stimuli. We are only aware of a small part of what our body senses. Before we become aware of being touched the stimuli has been through a long register of somatic (bodily) filters.

What happens when our skin is touched? How does the skin actually sense? Does touch happen in the epidermis that is outer layer of the skin, or deeper down inside the body? For the construction of systems using touch, it is of interest to look at what we can sense and how the body both registers, processes and forwards signal from skin to the brain.

In Ashley Montagu's view, based on medical evidence, the primacy of the tactile realm is confirmed: '[The skin] is the oldest and the most sensitive of our organs, our first medium of communication, and our most efficient

protector [...]. Even the transparent cornea of the eye is overlain by a layer of modified skin [...]. Touch is the parent of our eyes, ears, nose, and mouth. It is the sense which became differentiated into the others, a fact that seems to be recognized in the age-old evaluation of touch as ‘the mother of the senses’ (Montagu, 1971:3; Montagu cited in Pallasmaa, 2000).

The skin is not just the largest organ of our body, covering almost two square meters (Pascquero, 2006:7), but it also has an incredible sensibility and resolution. Think of how we easily can discriminate between feeling the crackle of broken glass versus the warmth of a hand gently touching another versus a violent blow? Or how the deaf blind can understand conversations in almost real time through the tactile communication system *Tadoma* (ibid, p. 5). *Tadoma* is a haptic language for the deaf and blind where the deaf-blind places their hands on the face of the speaking person to interpret the speech through the vibrations felt in their hands (Grunwald, 2008:79).

From the onset of a tactile stimuli onto the skin until the resulting perception, the user undergoes a range of complex mechanical, perceptual and cognitive phenomena (Pasquero, 2006). It is beyond the scope of this thesis to explain in detail what happens. However, it is important to have a basic understanding of how tactile information is physically formed, transmitted and understood. The aim is therefore to give a brief overview of how tactile touch functions from the physiological point of view.

3.2.1. Physiological functionality of the skin

The body’s perception of touch is a complex process involving neurological, chemical and mechanical elements. Through touch we perceive impressions such as pressure, vibration, temperature, pain and position. Through the skin alone we can also easily discriminate between sharp and dull objects, rough or smooth textures etc. Just as the number of our senses can be reduced to the extero- and interoceptive, the senses of touch can also be divided in two sub-systems (Haans, 2006 and Paterson, 2007:20). The *cutaneous* –or tactile– system deals with the outward-oriented, exteroceptive senses of pressure, vibration, pain, temperature and the *kinesthetic* system that deals with the inward-oriented, interoceptive sensations like movement and bodily positions in time and space. Together these two dimensions create the haptic perception, which is experienced as both tactile and kinesthetic. Kinesthetic movement of the body causes cutaneous issues such as stretching and pulling of the skin, and vice-versa. Therefore there cannot be a strict division between these two systems, but such a conceptual breakdown of touch into sub-systems and sub-elements is helpful in analyzing and understanding how touch functions.

3.2.2. The tactile senses of touch

The skin is commonly thought of as one flexible, sensuous, outer layer of the body. In reality it is composed of several layers and elements with various functionalities. Simplified the skin can be described as a layered structure composed of a variety of components like ridges, epidermis, dermis etc (Figure 3-1). These structures comprise of diverse and various biomechanical characteristics (Pasquero, 2006:9). The focus on touch -as it is experienced in my projects- is here on the perceptual impressions caused and conveyed via the outer skin. Therefore, this research centers on the general perceptual modalities of the human skin i.e. pressure, temperature and vibration. These three modalities constitute the organ, constantly detecting and reacting to environmental realities. Jill Scott adds proprioception as a fourth modality (Jill Scott in *Sk-interfaces*, 2007:62). Proprioception describes how we know how we are moving and which position our bodies are in. It has therefore also been called 'depth sensibility' (Grunwald, 2008:432). Proprioceptive embodiment provides us with information about three conditions: i) the state of our deep tissue, ii) our movements and activity, iii) the effects of displacement in space (Geurts, 2002:9). Even if parts of the proprioceptive sense necessarily involves receptors in the outer skin like stretching caused by movement, it is debatable as it is primarily muscular as well as belonging to the interoceptive system. As both the sense of kinaesthesia and proprioception relates to the 'muscle sense', they were often confused with each other in the early 19th century, but has subsequently become differentiated (Grunwald, 2008:33). One artistic example of the use of the proprioceptive sense is Stelarc's *Ping Body* project (section 4.7.3). Here the audience induces various proprioceptive positions to his body through a computer-interfaced muscle-stimulation system controlled over the internet (Paterson, 2007:115).

3.2.3. Skin receptors

As mentioned, there are several touch senses in the skin, each of which is associated with a different type of receptor embedded at a different levels (see figure 3-1). Some are sensitive to a light touch, others respond to pressure, thermoreceptors to temperature and others like the nociceptors signal pain. A nociceptor is a sensory receptor in both cutaneous and visceral tissues that signals when damage to the tissue and body occurs. It reacts by sending nerve signals to the spinal cord and brain. The perception of pain occurs through this process and is called nociception.

Likewise, also the other kinds of receptors convert the mechanical or thermal stimuli into electrical signals that are then transmitted through nerves to brain. This process is called sensory transduction. There are also some motor nerve fibres that carry impulses to dermal muscles and glands, causing

these structures to react. The four main types of skin mechanoreceptors of interest to haptic sensations are the *Pacinian corpuscle*, the *Merkel disks*, the *Meissner corpuscle* and the *Ruffini organ*. According to Pasquero (2006), the Pacinian corpuscles are encapsulated receptors found in the most superficial layers of the skin and transmit information about light pressure. This plays an important role in the discrimination of shapes, edges and texture. The Merkel disks are mainly responsible for the detection and identification of spatial patterns. These let humans recognize patterns such as the Braille dots and sharp edges. The Meissner corpuscle are densely packed in the human finger (150 units/cm²) and are only, but highly sensitive to dynamic skin deformations. This is important of detecting skin motion which again is useful for the accurate control of grip forces. Other receptors like the Pacinian corpuscles are located deeper and are optimized for detecting vibrations and, for example, moving a finger on rough material. These are quick and do not respond to steady stimuli. They have a much higher sensitivity to skin motion (200-300Hz) and therefore probably account, for example, of the remote perception of an object via a tool (Pasquero, 2006:8). So they provide information about dynamic qualities of stimulation.

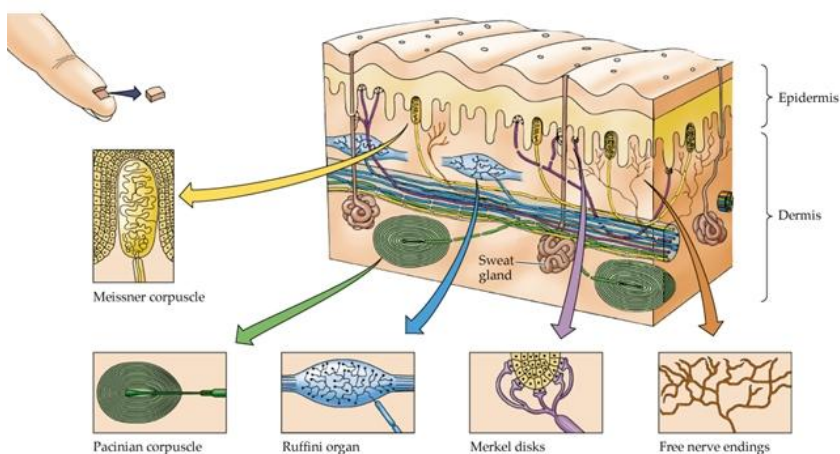


Figure 3-1 Skin layers: epidermis, dermis (above the subcutis) and placement of mechanoreceptors of the glabrous skin, image courtesy of http://grants.hhp.coe.uh.edu/clayne/6397/Unit4_files/image019.jpg

The sensation of pain is in general associated with the free nerve endings, but it appears that other receptors can function as nociceptors too (Iggo, 1974). An interesting aspect of this phenomenon relevant to this thesis is that pain does not happen in the nociceptors. Pain is a perceived phenomenon when the signals from the nociceptors reach the brain. As will be discussed in

chapter five on theory, also in medicine and neural science, perception is conceived as ‘a product of the brain’s abstraction and elaboration of sensory input’ (Kandel, 2000:437). A consequence of this is that ‘*there are no ‘painful stimuli’ – stimuli that invariably elicit the perception of pain in all individuals*’ (ibid). A question of interest to the development of haptic expressions is which impressions can be perceived as painful by more people. Since the perception of pleasure also arise through the same neurological processes, it is reasonable to expect that the same perceptual mechanisms cause sensations of the classical pair of pleasure and pain.

As described, the somatosensory system has specific instrumental characteristics. This also implies limitations. One consequence of the receptors’ limited capacity to register frequencies is that for instance that the skin cannot be used to hear human voices (Pasquero, 2006:3). It is simply not built for that. To translate sounds like alarms and simple signals into vibrations that again are perceivable through the skin is not a problem. A typical vibrator used to affect the skin, such as pager- and mobile phone motors, operate at sound levels between 0 and 200 Hz (rotational speed up to 12.000 rpm). This fits well with the described abilities of the mechano-receptors and shows that a basic knowledge of the possibilities as well as limitations of the sensory abilities of the different receptors is important in the design of a future haptic language for the skin. However, vibration-based languages like Tahoma are perceived through vibrations on the skin. This appears as a contraindication to the skin’s inability to hear. The explanation why Tahoma can be ‘heard’ through the skin and the hands is due to learned skills of associating certain vibrations and vibrational patterns with sounds and language. Although it is not at the centre of this discussion, Tahoma is as such an indication of how tactual communication can be constructed and even function on the level of a spoken language.

3.2.4. Summary and discussion of the physiology of touch

Aristotle’s division of the senses into five is one of several possible models to understand perception. Perception itself is much more interlinked and interdependent than commonly thought. The historical models explaining touch are various and point to a debate that still continuous. Touch is rather a conceptual umbrella covering a wide field of experiences than a sense. It is a multifaceted phenomenon to comprehend, even if the understanding of its physiological functions is medically and physiologically relatively advanced. It is a very diverse phenomenon covering experiences from chewing to social contacts to inner body movement. Therefore it is more descriptive to talk in the plural of the senses of touch than touch in a singular form.

Biomechanical models of the skin often simplify its functionalities. The explanation of the physiological function of touch given here is meant as a

basic overview of the physical construction of the skin and its ability to sense and encode touch function. In general there are five receptors that register cutaneous impressions. These are the Pacinian corpuscle, the Merkel disks, the Meissner corpuscle, the Ruffini organ as well as the free nerve endings. The bodysuits that I use in my projects ask the practical question of how the body and our perception can be influenced by touch. Due to my instrumental use of bodysuit this is mainly a cutaneous issue that is dealing with the basic sense modalities of touch through the outer skin as we know it through the Meissner, Pacinian corpuscle, the Ruffini organ and the Merkel disks. Important issues on touch that is only partially dealt with here are the proprioceptive, vestibular and kinaesthetic perception. These are part of the interoceptive system and deals with phenomena of touch inside the body such as movement and limbic positions.

Descriptions of the haptic abilities of skin often focus on the hands (Figure 3-1). This is most likely because it has a higher density of mechanoreceptors and correlates to Penfield's body maps (Figure 3-2) where the hands, feet and lips are areas of the body with a higher sensory resolution. My artistic work with haptic bodysuits focuses on covering most of the body, also those with lesser sensitivity. The physiological functionality of these areas is not mapped out, but in general it would be likely to expect that areas of the skin with a lesser sensitivity need lesser stimulation. This remains a question to be tested. Another question of interest is if the same cutaneous and physiological touch can have a universal meaning? As the example of nociceptors shows, pain is a sensation that arises in the brain. Whether one feels pleasure or pain is therefore, from a neurological and medical point of view, also a question of learning and other 'higher' cognitive functions. This question might also be conceived in terms of the difference between *sensation* and *perception* – the former as raw and unprocessed, the latter as cognitively processed. To understand the functionality of touch one must therefore include its psychology.

3.3. THE PSYCHOLOGY OF TOUCH

The psychology of touch examines the mechanisms of how touch is perceived. It looks at what happens when the signals and sensations (e.g., pressure, pain, warmth) from the somatosensory systems have reached the brain. This involves, for example, the cognition of touch: how do we know that what we touch is hard, sharp, pointy, warm, soft, good etc. Such perceptual information is instrumentally significant for understanding and constructing haptic impressions as exemplified in my work on bodysuits. It is not the aim of this introductory chapter to comprehensively cover the many topics of the psychology of touch. Instead it will concentrate on some

selected issues that are particularly relevant for the development of artistic works involving haptics in general and tactile stimuli in particular.

When entering an exhibition space and an artistic installation, how does touch influence our perception of it? As the senses can be divided into different systems and subsystems, also the cutaneous touch can be divided into categories. One model is, for example, to emphasize a difference in the *tactile* versus the *tactual* touch. *Tactual touch* refers to active exploratory action of touching and manipulative touch. *Tactile touch* refers to passive touch, like being touched (Schiff, 1982:xi) through the stimulation of the skin by some outside agent (Pasquero, 2006). This way of categorizing touch has been much debated. One question is whether or not the factual reception of touch is more important than categorizing it as active or passive. This is because, as nociceptors shows, sensations do not happen in the various receptors, but in the brain. Perception of touch appears as an activity that is primarily in the head, not in the body (Heller, 1991:8).

Various theories also show that there is no agreement about the mental perception of active versus passive touch. Vega-Bermudez et al assert that there is no difference between active and passive touch in form recognition, when the stimuli pattern is smaller than a finger pad (Vega-Bermudez, 1991). Shimoga (1992) identified five main approaches for finger touch feedback through visual, pneumatic, vibro-tactile, electro-tactile and neuromuscular stimulations (Burdea and Coiffet, 1994:86). Inspired by Uexküll's notion of 'active area', Skramlik developed a concept of haptic space (see section 5.3 and figure 5-2). He found that the body appears to have its own coordinate system and that this varies from the world around it: '*Haptic coordinate system varies from Euclidean geometry on all levels*' (Skramlik in Grunwald, 2008:34).

A question relevant for the Erotogod project is what happens when a touch is actively passive? When the users of Erotogod enter the installation they are seemingly passively kneeling down (chapter six). The installation will however, actively touch the users back according to their actions. In my experiments both active and passive forms of touch are used. Erotogod utilizes tactual touch when the users actively and autoerotically have to touch their own body. This action turns the body of the user into an object and lets the body sense tactile, indirect and passively. In this way tactual and tactile touch is combined in the same action.

Effects of the psychological perception of touch are many (Pasquero, 2006). One is *masking*, which is the phenomenon when the sensation of a first tactile stimuli makes it hard to perceive a second and different physical stimuli. The first perception *masks* the second out. Secondly, the phenomenon of vibrotactile adaption describes how we get corporeally habituated to a repeated stimuli. With the same vibrotactile stimulation in the

same spot over a longer period, users appear to become numb to that sensation. We adapt to the sensation, internalizing and normalizing it. This has its neurological explanation in observed decrease of firing rates at the mechanoreceptors level (Pasquero, 2006:11). Thirdly vibrotactile enhancement can occur as a consequence of a conditioning stimuli. If a user is ‘warned’ with a short vibrotactile burst ahead of the main stimuli, then the main stimuli can be sensed more strongly. This is the so called *enhancement effect* (Verrillo, 1993:291).

As briefly discussed in this section, there are many ways to touch and be touched. Relevant questions for this thesis are how and whether haptic experiences can be managed or engineered. As most psychological theories of touch sees it as a phenomenon happening in the brain and because of all evidence that touch can both be conditioned and channeled through contextual information, then the answer to this question appears positively confirmed. However, to see the perception of touch as such a brain dependent experience lures us into the ‘homunculus’ model of understanding perception (Heller, 1991:21). According to the homunculus model (see section 5.3.1) there is a small man inside our head that perceives, digests and controls the signaling and perceptive processes. Such a model explains touch comprehensively, but as will be discussed in chapter five, it is not acceptable from a phenomenological point of view.

This is further investigated in the section on of psychophysics, but first it is crucial to look at how touch affects us and our emotions.

3.3.1. Touch, affects and emotions

The life of the senses is intimately linked to the life of the emotions (Howes, 2005:399). Touch and affect are ambiguous and closely interrelated (Paterson, 2007:81). To haptically -and actively- reach out and touch someone can cause affect in others. Tactile –and passive- touch implies one is being affected. A working definition for affect would be referring to the experience of feeling or emotion. Emotions are often, but not necessarily caused by some kind of physical influence. Both the definitions as well as the differences between affect and emotion are many and often unclear (Lewis, Haviland-Jones, Feldman, 2008:10).

In my own work I have approached touch from a qualitative and holistic approach. My interest has been not only how touch affects us physically, but also -from the artistic point of view-particularly how it influences human affects and emotions. The presence as well as the absence of touch -as Aristotle said- can have a huge affect on living beings. The significance of touch can be overwhelming: *‘A short touch by another person can elicit strong emotional experiences; from the comforting experience of being touched by one’s spouse, to the experience of anxiety when touched by a*

stranger' (Haans, 2006:3). Touch as experienced through direct contact with other humans and in a social context is different from the touch an individual experiences when exploring objects and environments. Touch is here dealt with through the latter, singular perspective i.e. in situations and installations experienced by one user alone. However, the Erotogod installation that is at the core of this thesis (chapter six), is built upon expressions designed by humans and deals with humanlike expressions. Therefore it is somehow also a social experience to be touched in such installations. Also users tend to look for anthropocentric reasons why something appears as it is. We fill in the 'existential' gaps and make experiences meaningful – even if they not always are (Heijmans & Van Selm in Renckstorf, 2004:301). This is a critical moment in relation to the conception and design of emotional expressions, and should be considered when evaluating results and findings such as questionnaires.

In relation to aesthetics: how can touch affect us? What are the affectual relations between bodies and artworks? Can we sculpt with affects? Ovid's classical story of Pygmalion and Galatea portrays how emotions bring life into the arts. This timeless romantic story is a foundational myth for all sculptors and tells how the artist Pygmalion falls in love with the sculpture of the woman Galatea that he is making. The goddess of love, Aphrodite, seeing how much in love he is, breathes life into the sculpture. As Mirzoeff notes, Pygmalion has reproduced the ultimate narcissistic object: himself in a female form (Mirzoeff, 1995:68). This provides an interesting material for a psychoanalytic analysis. Here, however, we are concerned with the subjective issues of touch. And if we cannot - as Pygmalion's touch literally did - bring a lump of dead material into life, how can the passion and emotionality that I have observed in encounters with haptic works of art be explained (chapter six and seven)? Again, this could be another trick of anthropocentrism, and an anthropomorphosis: turning dead material into living human flesh (Paterson, 2007:82). This image is also '*a companion with which to think through a haptic aesthetics*' (ibid page 82). Then, how can the plastics of one body affect another body? How can touch produce such uncanny, fetishist and (almost) convincing emotions and affects? Installations like my Solve et Coagula installation (section 4.9) deals with the 'feeding' of an artificial intelligence that responds –or even lives- through touch felt in the user's bodysuit. This is within the realm of 'living' touch, but a touch that is never really the pressure of a real human/hand. Chapter four will present examples of how haptic sensations produced by touching technologies are artificial in themselves. To the body, haptic sensations are therefore not necessarily anything more than that what they appear to be, that is physical impressions.

Producing impressions of something living through mechanical-haptic technology is an artistic and therefore 'honest' deception, because –in line

with Bubner (section 6.8) - art is a deception in itself. This thread of thought is partially continued in Deleuze and Guattari's book *What is philosophy?* In their discussion on percepts, affects and concepts the art work is considered '*a bloc of sensations, a compound of percepts and affects*' (Deleuze and Guattari, 1994:164). The percepts are no longer living perceptions, nor are the affects any more lived feelings or affections. They are contained in the art object. They go on: '*the work of art is a being of sensation and nothing else: it exists in itself*'. Do Deleuze and Guattari hereby mean that works of art are immanent, existing for themselves and independently of the living, perceiving subject? In a way, since we '*paint, sculpt, compose and write sensations*' (ibid, p. 166). They involve the body, but it appears removed from the work of art: '*Flesh is not sensation, although it is involved in revealing it*' (ibid, p. 178). Further they say that '*sensation is realized in the material and does not exist outside of the realization*' (ibid). For Deleuze' and Guattari sensations appear tied to the work of art, but must not be seen as the artwork itself. It is a block of perceptions, but at the same time inseparable from the human experience. Deleuze and Guattari write this with reference to the work of art itself. But what happens when the flesh become the work of art? In relation to haptic installations the body of the user becomes a canvas and an artwork in itself. The user's body becomes a sensual body, a canvas for (aesthetic) touch. In this case, and following Massumi, Deleuze and Guattari's aesthetics cannot be reduced to a theory of the art object per se. They appear to understand aesthetics to be concerned with the dynamic of sensible assemblages. This is relevant for the context of haptic experience. Further, '*whenever an assemblage of affects and percepts appears, we have evidence of art differentiating itself as it develops an internal coherence of sensation*' (Massumi, 2002:63). Percepts and affects 'displace all fixed notions of identity to make room for a rich community of creative intensities' (ibid). Deleuze was inspired by Nietzsche and the passion he showed as an art-philosopher: '*... What is required ... is to stop courageously at the surface, the fold, the skin, to adore appearance, to believe in forms, tones, words ... to be superficial - out of profundity.*' (Nietzsche, 1974:38; Genosko, 2001:938 and Massumi, 2002).

Such an approach to aesthetics, to stop at the *skin*, appears superficial, but the senses are not at all that superficial and shallow. As noted by Game and Metcalfe (1996:58) and Paterson (2007), they can ground our perceptions through the skin: '*we feel meanings, a term that indicates the intimate association between bodily senses and emotion*' (Game and Metcalfe, 1996:58). A critical question towards the feeling of meanings is to which degree this is influenced by a culturally tuned perception. This will be further discussed in the section on culture and touch (section 3.4.1)

The close link between affect, emotions and touch is strong, but easy to trick. An example is the *Zombie Effect*. This is an artificial touch, like the one of a robot arm, that is mistaken for being real if its transmitted in a lifelike fashion, that is, not through cold plastic and steel, but warm and skin like materials (Bagnara/Smith, 2006:85). An additional example is how *vision-touch synaesthesia* can occur in phantom limbs (Grunwald, 2008:260). The *phantom limb* is marked by tactile, painful or motoric sensations in amputated limbs. Ramachandran and Rogers- Ramachandran have reproduced this sensory illusion of touch through mirrors (ibid). This was done through duplicating an image of a person's existing arm and visually presenting it as if it was the same person's amputated arm. Touching or moving the intact arm would cause a parallel sensation in the visualized phantom limb (ibid, p. 261). Similar technologies and approaches might be a stepping stone to imbuing materials in an installation with more affective and lifelike qualities. Paul Sermon's *Telematic Dreaming* (section 4.7.2) is an artistic example of such implementation and a demonstration of how affect and emotions can be –at least partially- influenced.

A further reason why the links between affect, emotion and touch are hard to objectify in a reproducible sense is because sensations cannot be measured in units of sensory magnitude. Instead one must use a qualitative measurement to observe changes in perception. It is a matter of stimuli-response relationship (Gescheider, 1997:70) where biological and learned, cultural elements all play their roles.

3.3.2. Affective computing

Emotions play an essential role in rational decision making, perception, learning and a variety of other functions (Picard, 1997:x). How do they influence our use of computing? Human behaviour towards machines is not always rational. An example is how large number of computer users are found to swear at their computers (Benyon, 2005:419). Such reactions can be rationally explained if one investigates the conditions behind such user reactions. The field of *affective computing* is concerned with how to detect human emotions, respond to it and utilize the knowledge of emotions in the design of applications and experiences. This represents an interesting field to test theories on affects and emotions. In relation to the challenge of creating specific feelings through touch, for example, a sensation of pleasure, there are a huge number of literatures about theories in emotion and cognition (Picard, 1997:22, Lewis et al, 2008). It is not the intention to cover these extensively here. Rather, the aim is to give a brief overview of the theories most prominent and used in understanding emotions. Just as one can reduce the sense modalities to two, the interoceptive and exteroceptive, emotions can in general be categorized in two approaches: *One* being that emotions are

cognitive, emphasizing their mental component, and, *two*, that emotions are physical, emphasizing their bodily component.

Physical research on emotions underlines the close relationship between emotions and corporeal reactions, like sweating in the hands in dangerous situations. William James initiated this research and findings that became the first of the three theories on emotions. The so called *James-Lange* theory proposes that certain stimuli cause bodily responses. These responses can be both autonomic and somatic. It is in sensing these changes to one's body that emotions arise (Fuller, Walsh & McGinley, 1997:297). This was challenged first by Walter Cannon who claimed that emotions are experienced centrally by the brain. What is known as the *Cannon-Bard* theory is a psychological theory suggesting that the first step is to feel emotions and then consequently act upon them. Thirdly Schachter and Singer showed that the brain must first evaluate in which situation each physiological change must be understood (Lyons, 1985:132). Their *two factor theory* of emotion is a social psychology theory that divides emotions into two factors: physiological arousal and cognition. Following this theory our cognitions are used to interpret the meaning of physiological reactions to our environment.

Current research is neither cognitive nor physical, but aware of the close interlinking between these two important factors for the production and sensation of emotions (Picard, 1997:22). Picard treats these extensively in her book '*Affective Computing*'. Here she terms 'sentic modulation' as the influence of emotion on bodily expressions (ibid, p. 25). Example of this is how we signal our emotions through changes in voice, facial expressions and corporeal posture. Some of these expressions are visible to others, some not. Respiration, heart rate, pulse, temperature, blood pressure, electrodermal response and muscle action potentials are all factors that must be measured through physical contact. Some of these physiological responses to emotions are seen even across cultures (ibid, p. 28), but they are not in themselves reliable measurements objective levels of emotions or specifically what emotion causes the bodily reaction. The cognitive aspects of emotion are also complicated to grasp (Picard, 1997:37). Studies of emotions show that many follow 'social display rules' that channel the way we find it appropriate to express our innermost expressions. This is a verbal and linguistic problem: How does one attach adjectives to ones feelings? And, even if two users feel the same, how can one be certain that they are using the same words to describe it? It appears that we cannot know this without very complex models. To predict –or even deduce– a person's emotional state of mind requires that we know the personal situation, goals, standards and preferences. If this is to be done, then it appears that highly specific and individual mapping of individuals must be done.

The question whether emotions are first of all either cognitive or physical is less important for this research. My approach is foremost concerned with the use and understanding of how touch and emotions are produced and conceived as a result of complex and multimodal stimuli and situations. An important measure here is the sensation of pleasure. The pleasure principle, as inspired by Darwin's initial observations of how animals seem to pursue pleasure, can be described as '*an innate tendency to want to maximise pleasure and minimize pain*' (Badcock, 1988:16).

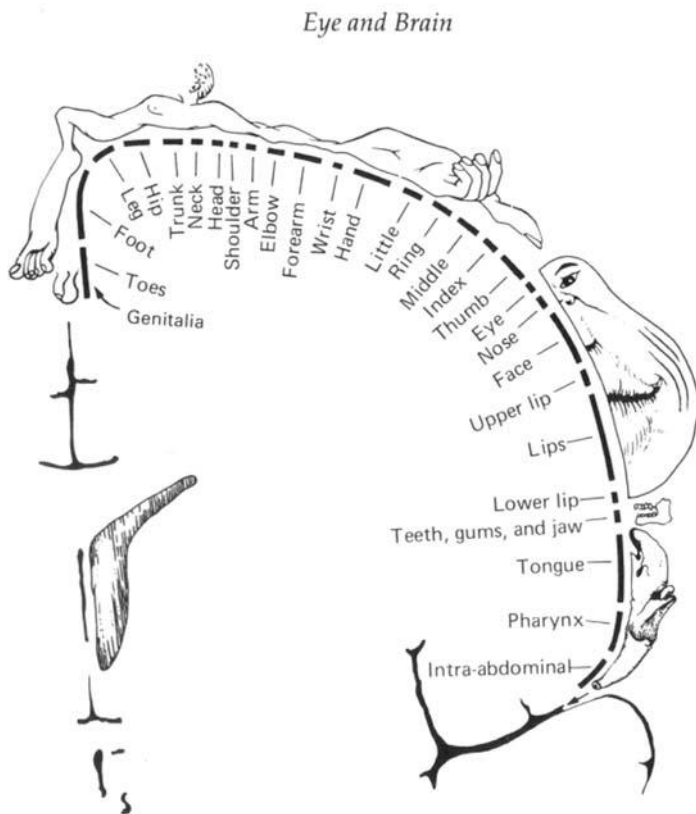
As an artist dealing with haptic experiences, it is always a positive experience to see a user expressing pleasure. Pleasure in itself is no primary emotion (Benyon, 2005:438), nor is it necessarily the expression of a specific condition. It can even sometime occur out of unpleasant stimuli. No matter what causes it, it is a state of emotionality that is interesting -and hard- to reproduce. In my installations I have tried to design certain pleasant stages and experiences, such as touch patterns, tonal expressions and material properties of the bodysuits. Some of these alone or in combinations seem to produce pleasurable affects in the user.

How does one understand and think about pleasure? The anthropologist Lionel Tiger has developed a four dimensional framework for this (2000). The first, *physio-pleasure*, is concerned with the body and senses and include the sensory experiences involving the sexual organs, sensations of taste, food, smell as well as more general physical impressions through massages, exercising, swimming, sunbathing and others. The second, *socio-pleasure*, arise from relationships with others. The third, *psycho-pleasure*, is caused by satisfaction of individuals completion of a task, however mundane. The fourth, *ideo-pleasure*, is the sensation of mental, aesthetic and often intensively private pleasure out of experiencing theoretical entities such as movies, buildings, plays, music, art and many others (Tiger, 2000:59). This coarse four-fold classification of pleasant emotions provides conceptual containers that are easy to label and understand. However, pleasure is not something caused by either or, but from complex intermingling of stimuli and categories of emotions. Having this in mind, and following Benyon et al, Tiger's approach can be a useful tool for the design of haptic content and applications. In the case of my projects I have focused in particular on *physio-pleasure* as represented in my various bodysuits (see chapter four, six and section 6.8). I have not worked from an absolute schema of emotions and affects since an approximate identification and representation of them seem to suffice for most applications (Benyon, 2005:445). When dealing with cutaneous touch we are dealing with two square meters packed with the various mechanoreceptors. Can, for example, a touch that causes pleasure be applied anywhere on the body? Common knowledge tells us that this is not

the case. As the next section will show, affects and emotions appear hard-wired to certain areas of the body.

3.3.3. Body maps

As shown, there are a large number of factors and dependencies behind the feeling of touch. In our everyday lives we usually do not think of this. The body usually appears as natural and given. But, how does the body know itself? This apparently strange question can be exemplified through tooth brushing. When brushing the teeth you don't need to see your mouth or what you do.



4.2 A homunculus, showing how much cortex is devoted to touch sensation from various regions of the body. Note the huge thumb. Different animals have different homunculi, corresponding to the sensory importance of various parts of the body.

Figure 3-2 Penfield's body map on the correlation between brain 'size' and touch sensation.

Image source: www.christianhubert.com/writings/brain.html

How does the hand find its way to the mouth without visual aid? This seems easy, but research on robotics shows how hard that is to programme (Vassnes, 2009). Through years of neurological training humans have an inner understanding and mental map of what is happening to the body and what to do with it. But not all parts of the body are as knowing as others. Wilder Penfield was able to draw a correlating map between the body and brain by using electrodes on the brains of epileptic patients (Andreasen, 2004:55). When the electrode touched the brain the patients described their sensations. This enabled Penfield to draw a map of the body – in the brain (Vassnes, 2009).

The illustration 3-2 shows how much of the brain is used to register touch in the different body parts. As the illustration portrays, the sensory-registration of the body is not equally distributed or portrayed as ‘anatomically correct’ in the brain, rather it is distorted compared to a one-to-one, figurative distribution. The brain maps and ‘feels’ the body quite differently in proportion to the actual size of the body part. For example the sensory capacity of the lips is huge, whereas the back is small, reflecting the relatively modest importance of touch on the back. The maps depict how some body parts have more ‘computing’ power from the brain, others less. The hands, the lips and the tongue for instance are able to very precisely distinguish between small details. They have a very high sensory resolution compared to, for example, the legs or the upper arms. Therefore they occupy a large area of the brain. This mapping explains how, for example, golf players can feel that their club becomes a part and natural extension of the body. The Virtual Reality (VR) pioneer Jaron Lanier calls it ‘*homuncular flexibility*’. This is derived from the ‘*homunculus*’ phenomenon of Descartes (section 5.3.1) and describes how we get used to telepresent working through acquiring *third limbs*, extensions of the body. The knowledge of these body maps can be significant for the use of touch and how the senses of touch are applied. One hypothesis derived from the body maps is that the legs and the back seem less sensible to direct physical stimulation than the face and hands. This is a highly relevant question for the construction of haptic stimuli and bodysuits. If it is found to be correct, it points to a possible need for higher density of effectors (output) and sensors (input) on the body parts with high ‘neural coverage’ (hands, lips, tongue etc.). Such correlative design between body maps and bodysuits can possibly make bodysuit design easier and more effective in terms of sensory corporeal communication.

A critical issue is whether the mapping of sensory-motor skills to the brain is hard-wired for life or if it can be subject to change. As Sandy Stone argues (section 3.3.6) and according to the Hug-Shirt project (section 4.7.6), these correlations are not completely set. They can be psychophysically

influenced and partly re-wired through cognitive training and physical remapping of sensations.

3.3.4. Psychophysics

Psychophysics is the relation between physical stimulation and mental perceptions of sensations (Gescheider, 1997:ix). The psychophysical dimensions of the mutual relations and interchanges of the psychical and physical in humans represent one of the fundamental problems of modern psychology. Long before Aristotle's writings, sensations have been an object of study. Understanding how sensation functions is thought to yield insight into the working of the human mind (ibid, page ix). The foundation of modern psychophysics was laid by Gustav Fechner when he published his '*Elemente der Psychophysik*' in 1860. Here he proposes that bodily facts and conscious facts are different sides of one reality. He defined psychophysics as the '*functionally dependent relations of body and soul, or more generally, of the material and the mental, of the physical and the psychological worlds*' (Kimble, 1996:6). Accordingly the previously unresolved conflict between the material and the 'spiritual' world was solved by considering them as two sides of an identity.

The famous Weber–Fechner law states that the relationship between stimuli and perception is logarithmic.³² In terms of sound this means that the frequencies of notes that are perceived equally apart are related by a multiplicative factor.³³ It is a description of a function from '*stimuli intensity to percept intensity*' (Horst, 2000). The Weber–Fechner law can also be described as a mathematical analogy to the mind/body interaction of Descartes. Its relevance to the use of haptics is how the experimental combinations of physical stimuli generate other and new (mental) perceptions. Do for instance stronger physical vibrations in the groin produce perceptions of a better pleasure? The physiological adaption issues such as masking and vibrotactile adaption would most likely put the Weber-Fechner law to a test that is hard to pass, but this has not been attempted formally in my experiments. My approach to psychophysics has not just been technological, but also environmental. Through my artistic projects it has been my experience that the physical design of the installation in relation to the environment influences the behaviour and perception of users. Hence my particular approach to psychophysics is interested in how the relationship between the artistic and aesthetic coding of an installation influences the perception of it. The design of the Erotogod installation (chapter six) is an example of how the psychophysical dimension becomes a

³² <http://en.wikipedia.org/wiki/Logarithm#Psychology> accessed on April 5th 2010.

³³ http://en.wikipedia.org/wiki/Weber-Fechner_law accessed on April 5th 2010.

psychotechnological tool. It functions as an additional layer that contributes to the overall shaping of the sensations experienced inside the installation.

3.3.5. Psychotechnology

Psychotechnology is about the applied dimension of psychology (Warren, 1998:128). As a method it is highly relevant to the construction of artistic works utilizing perception. It starts with the design of the environment of an artwork. Whether shown in a ‘white cube’ or public space, often a work of art is deliberately given a specific appearance serving as a framework for the construction of engineered experiences. Such use of psychology as a technology to code our experience and environment is illustrated through the following example:

What is the champagne dinner followed by soft music and low lighting but an induction technique aimed at producing specific states of body/mind and behavior? - Julian Isaacs.³⁴

It appears that most people in the setting above instinctively try to design a seductive setting. But what is a more seductive setting? Decorating the environment as above with lit candles is one, providing smell and colour through flowers is a second and adding wine to affect our consciousness a third. These three elements are used as parts in a deliberately instrumental action where the purpose is to directly affect our perception and possibly our actions. The sensations experienced under these conditions will most likely appear different from a dinner served in a dark basement lit with cold, fluorescent lamps and lukewarm water served. Similarly to the traditional wine/candles/music art of seduction my installation designs functions as *psychotechnological* tools in that they aim at producing specific emotional responsiveness and sensations. Many of my installations intentionally employ atypical designs through sculptural forms (see SeC installation, figure 4-26) and the texture of clothing to promote a general sensation of difference from other environments (chapter six). Designing installations so that they appear more or less incomparable to others can influence our expectations of functionality and experience. A reset of expectations of what can occur could possibly make users less judgmental of what can and will happen. The positive responses to the Erotogod installation (chapter six) and my observation of the user’s lack of vocabulary (chapter seven) to explain the haptic sensations could be an indication of this.

The design of the champagne dinner above can be seen as a result of distinct cultural and therefore learned behaviour. Whether cultural or

³⁴ <http://www.mindmodulations.com/resources/General-psychotech.html> accessed on March 10th 2010.

biological, of concern to my approach is how material and physical elements can be applied as a technology to influence others. One of the main interests to this research is whether the psychotechnological application of vibrotactile patterns can induce specific and repeatable sensations or not. This will be further discussed throughout the thesis.

The area of psychotechnology understands psychology as a concrete technology to be utilized for manipulation of perceptions. It is a technology to alter the beliefs, perceptions, and feelings of people (Metz, 2000). However, it can also be seen as an instance of the more general psychophysical approach. This thesis will therefore use psychophysics as a general terminology of applied psychological and physiological factors that influence and direct the user's behaviour and perceptions.

3.3.6. Psychophysical induction technologies

Seeing that both mental and physical elements can influence our perceptions, how can one psychologically *and* physically, that is psycho-physically, code our environment to facilitate the experience of specific sensations?

Psychophysical induction technology is a term that can describe the – often tacitly applied- physical installation- and environmentally-based manipulation that many artists and designers utilize to stimulate and incite deliberate feelings. The psychologist Obonai (Imada, 2002:402) used this term to explain how some visual stimuli patterns induce certain haptic excitation and inhibition processes. This implies that we can feel by sight and see by touch. Another example of this is Merabet et al. (2004), who shows how cross-modal processing is possible in the brain. Areas normally implicated in visual perception are active during tactile and auditory tasks, and vice-versa. Neurologically speaking this shows how perception functions across sense modalities and that they cannot be separated as in Aristotle's categories of the five senses. It also represents interesting findings in relation to synaesthetic sensations. The next section will be going into some more detail, as cross-modal perception is potentially at the heart of a 'haptic language'.

An interesting case of psychophysical induction is Sandy Stone's performance on transpositioning her clitoris from its physiological origin to the palm of her hands. She mentally moves her skin functions and '*maps (her) clitoris to the palm of (her) left hand ... and then proceeds to do sexual things with it*' (Stone, 1997). This is done until the point of orgasm, or -since it is always done as a demonstration for an audience- at least performed orgasm. This phenomenon of transpositioning is known from therapy of people who have had severe accidents that have paralyzed their bodies. In order for them to sense erotic stimuli they have to move their sexual centre to an area sensitive to touch somewhere else on the body. One such place which

not often touched is under the jaw bone. Therefore it is usually very sensitive and people can be trained to have orgasms by touching themselves there (ibid).

These examples indicate that a practical use of psycho physical induction technologies will more often than not involve cross-modal interaction between several sense modalities.

3.3.7. Cross-modal interaction

The art of imprinting humans with feelings deals with much more than physical sensations and technologies. In neuroscience cross-modal interaction describes how sensory data are complemented by each other. How the cross-modal manipulation of sight and touch functions in practice is shown in Paul Sermons interactive art installation '*Telematic dreaming*' (section 4.7.2). Here a mental sensation of touch is provoked through imagery. As Classen observe, no direct tactile stimulation does not mean that the sense of touch is disengaged (Classen, 2005:405). '*Telematic dreaming*' exemplifies the impression of mental touch. This video-based piece contains no direct tactile stimulation. This, however, does not mean that the sense of touch is disengaged (ibid) as user report experiencing touch-like sensations. The video show how the distant users touch each other, thereby influence and code the mental perception of factual touch. The video installation becomes a psycho physical induction technology for the experience of physical sensations. It is an artwork constructed of consensually hallucinated feelings. Lying on top of the video projection users visually appear to touch each other. Hence they also report having experienced it. But factually they have only touched an empty surface –or been 'touched' by a projection. In this way the work deals more with mental construction of haptic sensations than with touch technologies.

How corporeal sensations can be triggered by using words is not just known from storytelling, but becomes more and more familiar through text-based virtual realities like chatting, Muds (Multi User Dungeons) and MOOs (Stone, 1996). Interactions in these online and real-time environments for multiple users show how sensations are induced in real time. One example of induced corporeal experience is the '*Furry Muck*' community (Ludlow, 1996:339). Here users create text-based, online and anthropomorphized identities of themselves as highly sexualized alien animals. An example of a possible female identity is 'green skinned squirrel walking around naked'. The users mental focus on strong corporeal stimuli in combination with the textually expressive 'appearances' made users report feelings of real sensations. Such plays with identity and appearance mentally call forth different expectations both for the subject behind the 'handle' (online identity) and for those communicating with 'it'. The textual

descriptions both of users, actions and environment provide a mental framework for what to look for. The psycho physical induction technologies here consists of using texts to mentally structure and sensitize user's attitudes towards certain physical behaviours or reactions.

In the artistic field, haptic aesthetics also refers to how the visual can provoke sensations of touch. In this context Mark Paterson remarks that '*art can and should be a touching experience*' (Paterson, 2007:79). Laura Marks coins the term *haptic visuality* referring to what Sobchack calls volitional, deliberate vision where '*the act of viewing, seen in the terms of existential phenomenology, is one in which both I and the object of my vision constitute each other*'. Further, the image becomes haptic in that it invites the viewer to dissolve his or her subjectivity in the close and bodily contact with the image (Marks, 2002:3). This makes it to a certain degree possible to anticipate what one feels by observing it. Visually induced haptic illusions can make us see the feeling. In experiments where participants visually interact with virtual objects on screen, like a spring, haptic sensations of physical resistance has been reported. This occurs '*even though no haptic feedback was present*' (Haans, 2006:6). Further research is necessary to find out both to quantify this perceptual illusion and to find out which consequences such cross-modal influence has on the senses as well as how this can be used both to understand and design haptic expressions. '*It is clear that this kind of cross-modal transfer will be relevant to the design of haptic interfaces*' (ibid).

3.3.8. Psychophysics in the arts

This thesis examines how physical touch is perceived in the context of virtual, media-based environments where experience is a matter of combining real, physical experience with the mental perception (coding, expectation). As mentioned above, this is a matter of psychophysical induction technologies.

The reason for involving art and media into research is that media arts have a unique way of operating between real sensations (interfaces) and the design of mental- and contextual space. To again return to Sennett's quote, one of the advantages of practice based research is that practice – as the work of art- demonstrates thinking. Works of art present us with empirical *material* and – in the case of media art- with empirical *experiences*. As discussed in section 2.3, what makes this material and experience so difficult in research contexts is its tacit nature.

The visual arts have a long tradition of combining real and material expression with contextual coding. The relational aesthetics of Bourriaud (2002) exemplify this. One of this thesis' contributions to the field is constructing haptic experiences that link mental expectations and experiences to the actual physical environment. Haptic technologies strengthen the

connection between the mental and objective environment. Haptic experiences bridge the gap between the real and the virtual. It transforms the corporeal stimulation into a tool for influencing mental phenomena.

The sensations of haptic experience through multisensory interfaces as shown in my projects (chapter four and six) represent ways of coding real touch. The users' sensation of real-virtual touch will - similarly to textual stories of touch - be filtered, decoded and influenced by the mental understanding and expectation in the user. *Haptic storytelling* (chapter 4 and section 6.9) can be seen as a combination of the psychological perception of touch together with the actual experience of real touch and physical impressions.

Erotogod uses such a psycho-physical approach. Indirectly it should therefore be able to reveal more of what happens to human perception when strength and loudness of a stimuli is increased (Weber-Fechner law), how perception can be manipulated and how it changes when different stimuli are combined at different strengths and in less familiar combinations.

However, such psychotechnological approaches do not always work. Our experiences and expectations are also socially coded (Dourish 2004). That such techniques sometimes work is not a proof that they always produce a certain state of mind, atmosphere etc for all users. One and the same situation can produce very different moods. Humans have different biographies. Consequently, where one person feels coziness by seeing candle light and hearing soft music, the other think of not having paid their electricity bill and the third of strangling his aunt to the sound of soft music (Früchtl 1996). In contrary to bodily sensations, moods have no reflection outside oneself, but reflect one's own '*Gestimmtheit*', that is how one is 'attuned' to an experience. To understand the physical and psychological elements of touch involves the framing of the phenomenon.

3.4. THE PHENOMENOLOGY OF TOUCH

As psychophysics shows, touch cannot be explained by neural data alone. In combination with psychological mechanisms a seemingly functional psychophysical approach is possible, however what is lacking is an overall explanation why touch functions. As an expression of the relative complexity making up our skin, is the following statement issued for the SK-interface conference and exhibition in 2008: '*Skin represents a place where art, science, biopolitics, philosophy and social culture inter-face. Materially and metaphorically, artists replace borders that tend to separate by membranes*

*that need to be negotiated; between spaces, species, gender, senses, disciplines and genres.*³⁵

A theory of touch must accommodate the *phenomenological* information about the ‘appearance of the stimuli’ (Horst, 2000:9) to describe the comparative picture of touch. Accordingly, as mentioned in the introduction, a phenomenology of touch explores the experience of touch and, consequently, how the meaning of touch arises and how that casts light on the general way we are embodied and ‘find ourselves in a world’ (Ratcliffe, 2008:299).

In phenomenology the object of study is our *experience* (Smith, D. W, 2005). It is a field trying to understand how we experience *overall*. Phenomenologically, the physical origin of experience becomes central. This is in line with Merleau-Ponty’s view on embodied experiences (section 5.6.1).

As the phenomenology of touch necessarily also deals with the construction of meaning through touch, how do we make touch become meaningful? How precisely can psycho-physiological combinations of touches create and recreate meaning? These questions are not just instrumental in nature, but concerns a long chain of interacting issues and aspects of life that influence our perception. As mentioned, Merleau-Ponty gathers these diverse factors that affect and influence us under the term the ‘intentional arc’. Also as Dreyfus & Dreyfus note (section 5.8), the affordance of the world goes beyond biology and must, phenomenologically speaking, include historical and cultural elements as well. The field of phenomenology in relation to touch will be further discussed in chapter five.

The beginning of this chapter dealt with the historical development of theories of perception. As touch appears to affect several if not all aspects of human life, this thesis is also about the *phenomenology* of touch. In phenomenology the object of study is our experience and what is directly given to perception (chapter 5, section 5.4 and 5.5). There is therefore a strong relationship between psychophysical experimentation and phenomenological experience. The psychophysical dimension prepares the ground for phenomenological experiences. Phenomenology here becomes a reflective tool useful to me as an artist and practitioner both in terms of conceiving, constructing as well as understanding the artistic experience.

Adding to the complexity of phenomena affecting touch, this section will end with a brief comment on the cultural components of touch.

³⁵ From the FACT press release for the Sk-interface exhibition, downloaded from <http://www.fact.co.uk/news/?id=143> on November 22nd 2009.

3.4.1. Culture and touch

Is it, that the body, as we have come to understand it, no longer exists? - William A. Ewing, 1994.

How do we learn to understand touch? As Ewing's question above implicitly suggests, touch has a strong cultural, learnt component. The body can be seen as a construction that we have to learn. If we learn to see the body as something else, then the body as we knew it ceases to exist. It is replaced by a new, learned body that filters and affects our perception differently from the old one. The extreme plasticity of the body percept is reflected in Merleau-Ponty's claim that the body is 'an historical idea' rather than 'a natural species'. Inspired by this Simone de Beauvoir claims in her book *The Second Sex* that being a woman, and by any extension, any gender is an historical situation rather than a natural fact (Auslander, 2003:98).

A conception of the body of the 'virtual age' is such a mouldable body where a new 'body-brain' connection has happened (Hansen, 2004:5). A wide range of new 'bodies' and identities have come with the advent of Virtual Reality technologies. Some are *multiple personality disorder* (MPD), virtual bodies and liquid identities and not to forget the post-human discussion (Pepperell, 1995). MPD came to fashion as both an answer and a response to all the virtual *handles* (identities) one can have on the internet. The term covers a wide range of dissociation disorders, but there is discussion if MPD exists as a real disorder. Cultural comparisons between US and India have found that 'cultural context constructs unique forms of mental states and strongly influences which experiences are normal and which are pathological' (Mezzich, 2002:18). This connects to cross-cultural constructions of the body. As such it is relevant in terms of setting the psychophysical framework of artistic, multimodal and computer-based environments.

There is strong evidence showing how our interpretation of touch is strongly influenced by cultural elements. Cross-cultural anthropological studies confirm how culture affects perception (Classen 2005). One is the wide register of cultural differences in the amount and type of touching. In relation to social contact, anthropologists have distinguished between so called contact- and non-contact cultures (Argyle, 1988:60). That human's way of touching apparently easily can be recognized and divided in two is in itself an indication of the cultural component of touch. How does culture influence perceptions of touch? One example is the Cashinahua Indians of Eastern Peru ways of seeing the body as composed by different bodily intelligences and where their skin *knows*. In their everyday setting they let their bodies merge with the environment in a quite different way compared to

an ordinary, design-oriented workspace in the western world (David Howes in Classen, 2005:27). The Indian way of understanding their bodies influence their perceptions. In their everyday environment, smells, colours, and the texture of the ground they walk upon afford different perceptions from an office worker. The culture evolving around their everyday conditions seem to have further refined their bodily ‘directedness’ towards specific touch phenomena. Geurts (2002) describes the African Anlo speaker’s term *seselame* that describes hearing or feeling with the body, flesh or skin. This is similar to the Cashinahua Indians and is another indication of how the body becomes ‘the existential ground of culture and self’ (Csordas in Geurts, 2002:149).

In the history of perception, touch has delivered ‘raw’ data and information to philosophy and philosophical thinking about touch. My findings and projects present a different approach to touch. The point of view can just as well be inverted and, as the Cashinahua shows, the skin can be seen as knowing. Why not see touch as thinking? The instrumental-theoretical approach to touch as a tool to ‘test’ theories is not my centre of attention. Through western thinking of touch as ‘brute physicality’ it has built an ideological barrier against alternative ways of understanding touch (Classen, 2005:5). My approach to touch is primarily from the point of view of a practitioner and seeing touch as a tool for experience. Therefore my works are primarily interested in the technological rather than the ideological manipulation of touch. In itself the technological dimension is no neutral ground, but rather the result of complex, intertwined factors where one’s culture plays a significant role. It is not possible to discuss these issues sufficiently within the limits of this thesis, but it is of importance to know of this background. Some relevant questions that will be touched upon are, for the particular, if the culturally coded perception of touch is something that single art works can influence? In general, how does one apply our cultural understanding in the making and experience of haptic art? How does the perception of touch change in relation to a changing culture?

Through learning, does culture overrule the other biological processes? Similar to Sandy Stone’s remapping of the skin functionalities, it seems culture does not overrule, but channels the way we understand, interpret and form meanings of touch. Haptic language and *haptic storytelling* (section 6.9) takes the onset that biological conditions of the human body do not only support cognitive processes, but also cultural adaptations including narratives. As Jerome Bruner says: *‘the child does not enter the life of his or her group as a private and autistic sport of primary processes, but rather as a participant in a larger public process in which public meanings are negotiated’* (Bruner, 1990:13).

Feelings and affects have strong neurological origins, but can also be read as learned experience in line with Bourdieu's notion of cultural knowledge (Levinson, 2002:121). In Bourdieu's view we possess a certain cultural background that enables us to experience something as something. This becomes a referential backdrop for our culturally coded interpretation. According to Bourdieu, aesthetics is not a universal human faculty, but a taste that has evolved as a result of and as a complex marker of social position (Thomson, 2006:77). It therefore appears that our perception of touch changes as a result of changes in culture. Culture forms an instrument that focus how we interpret touch. In all its immediacy and through all its complex factors, touch can be seen as a situated concept, existing there and then as a consequence of a specific matrix of interrelated phenomena: '*a situated concept is formed by a particular activity, a predicted context and an interpretative culture*' (Bode/Schmidt, 2008:9). It here appears that culture frames our interpretation of stimuli, and if the artistic goal is, like Bode /Schmidt, 'to make relevant statements about the world' (ibid, p.13), then cultural factors must be taken into consideration. According to Bourdieu, artworks are products of a reciprocal process of production and reception in history (Robbins, 2000:56). A test case to see how our perception is influenced as well as changed is a situation of extreme harmony: what if the meaning of a touch given is perceived *identical* by two recipients (ibid, p.57)? Then both would possess identical codes of perception and production. This seems highly unlikely, not at least given the wide range of subjectively differences between all humans. Codes can be learnt, and perceptions approximately be similar, but it appears unlikely that they will ever be *exactly* the same. Understanding art means deciphering it on the basis of some code that the viewer masters. One implication of this is that 'the work of art exists as such to the extent that it is perceived' (Bourdieu, 1968:170). This outlines Bourdieu's 'sociological theory of art perception' (Bourdieu, 1968:589-612; Tanner, 2003:164) and implies that art is dependent on culturally coded perception. Possible consequences are many in relation to the making of works of art. In the case of *virtual touch*, it also indicates that touch both is and must be learnt. A future haptic language must incorporate this consideration.

Mark Hansen's work on philosophy for new media examines new media art and theory through Henri Bergson's argument that *affection* and *memory* render perception impure. According to Hansen we have mechanisms of selection where we select and choose only specific body-images that we feel relevant to ourselves. (Hansen, 2004) (Oddey and White, 2009:291). The question of how a given culture colours perception becomes relevant here - which selections does our culture allow, favor or stimulate? And which not? In my work I have placed myself in the tradition and setting of new media

art. This can be seen as a western, white, technologically-marked culture. Yet, since it is so recent, it can also be said to be relatively open.

One question is how the cultural complexity of *touch* affects my works with touch? In line with the (autoethnographical) approach I have built my projects with myself as a cultural point of reference. What functions for me is what I have brought on in my projects, not what I think others would like to have. The reference culture has its roots in my corporeality which is a white, western European male brought up in a protestant culture in Scandinavia. I do have extensive training in yoga and new Hindu thinking. I also have my training in an international high school. These are some of the factors that contextualize my thinking and projects. These factors are perhaps neither essential nor unique, but important to be aware of and to include as a self-critical stance. This posture will serve as a background in the analysis of the questionnaire in chapter seven.

All in all this shows not only how cultural conditions influence our perceptions of touch but also how it enters the circle of complex factors that are part of any touching experience. Corporeal experience, epistemological reflection, and cultural conditioning are just some of the ingredients that affect my works. An unresolved question is which experiences of touch humans have in common? Which touch is cross-culturally the same? Given the cross-cultural variations in the body and the senses outlined above, the question then becomes: are there any *universals*, codes that work across cultures? Does our tactile neurology form some kind of structural background from which experience is 'given'? The case of Stone remapping the clitoris indicates that any answer is currently unclear. However, this is an important question to ask when investigating a haptic 'language'. If we can find evidence of any *universals*, we also find another building block for a common haptic language. This points towards an interesting field for future research.

3.5. SUMMARY AND DISCUSSION

This chapter has examined the fundamental features of touch, the process of touch from 'the skin to the brain' and how related ideas and theories contribute to the construction of the meaning of touch. One thing shown is that touch in itself is an unspecific sense. Therefore this excursion into how we *corporeally register, psychologically process and phenomenologically reflect* touch has been necessary to understand the fundamentals of the role touch plays for humans and how the achieved knowledge can be used to build meaningful haptic experiences through art and media.

Touch is often understood as a specific sense, but it is not. Touch is a diverse phenomenon involving a wide range of experiences from social proximity to inner body movement. Within this range this thesis will focus on

the tactile sensation of pressures. This provides a functional approach to understanding and perceiving touch today.

Physiologically, touch comes from a wide range of mechanoreceptors and nerves. These transmit signals to the brain. As the example of nociception indicates, the sensation of pain as well as other perceptions is produced in the brain. This points to the intricate relationship between the body and the mind coming together in the field of psychophysics.

Earlier and in a practical context, the bodymaps of Penfield lead to the question if the legs or the back need less direct physical stimulation than the lips. From a physiological point of view this might be the case, but psychophysics shows how our interpretation of the body is also dependent on other factors. One is the cultural understanding of touch. As discussed in the section on culture and touch, what if –like for the Cashinahua Indians- the legs are of crucial importance in a given culture? How do cultural elements change the meaning of touch over time? Then a phenomenological twist could perhaps occur and focus our attention and corporeal consciousness towards such a lesser ‘important’ bodypart according to bodymaps.

As Sandy Stone’s transpositioning experiment shows, it is possible to remap erogenous zones for touch from one place on the body to another. These examples show how the sensations of touch raise complex questions touching upon a range of physiological (biological), psychological (mental) as well as cultural issues.

A basic understanding of the physiological, psychological, and phenomenological functionalities of touch is relevant to expanding on our everyday and tacit use of haptic expressions. Key questions are therefore how one applies this knowledge to haptically express oneself? How does one interpret touch? And how does one ‘speak’ touch? Psychophysically our haptic expressivity appears to correlate to our skills and knowledge of touch. If this is the case, then it is also an indication of a possibly intersubjective vocabulary of haptics. Such a vocabulary can be one foundation for expressions of touch. A goal of this research is to go through the findings of my various projects on haptics and look for a phenomenological basis for haptic expressions.

Issues pertaining to touch are more complex than was commonly thought. To understand it, a chain of biological, cultural and technological issues must be taken into consideration. There is no single cause or effect in situations involving touch. Touch needs therefore to be investigated from multiple viewpoints. Concerning the matter of this thesis – the experience of touch in artistic installations- the main emphasis of my works on touch has been on vibrotactile stimuli. As the complexity issue shows, vibrotactile stimuli cannot entirely be investigated alone. Rather, investigations of touch have to involve a wide range of somatosensory, cutaneous and haptic issues. Also

relevant for the forming of my own critically-informed practice is the recognition that the complex relationships between forms of knowledge involve not just conceptual, but also bodily and emotional dimensions (Kemp and Tangenberg, 2002).

Having dealt with some of the basic components making up our experience of touch, how does this relate to the different applications of touch in art and media? The next chapter will give an overview of projects and research relevant to the use of haptic and tactile stimuli in art.

4. OVERVIEW OF RESEARCH INTO TOUCH AND TOUCHING TECHNOLOGIES

Any sufficiently advanced technology is indistinguishable from magic. - Arthur C. Clarke's third law (1962).

In the attempt to frame the field of touch in digital art, this chapter will first focus on historical and technological developments leading to immersive and multimodal environments. Then it will centre on touch as a specific medium and expression utilized in digital art. Here the fields of telepresence, immersion and tactility are central phenomena that can naturally merge together. The chapter will proceed from examples of related visual expressions in media art towards immersive works before describing relevant multisensory and haptic possibilities. The chapter aims at providing a relevant background for the understanding of how touch is used in my projects. The description of the various haptic technologies and projects further represents an alternative haptic history of VR. The chapter introduces the term *haptic storytelling* to illustrate how touch can be used to tell a story.

4.1. INTRODUCING DIGITAL MEDIA ART

The purpose of the following brief history of digital media art is to give an overview of relevant milestones in the field that have contributed to the understanding and use of touch both as a material and as expression. The haptic technologies described in this thesis are to be seen in the context of digital media and digital art. There is one important technological distinction between visual art and digital media art. The latter is built upon some kind of electronic equipment that enables changeable and dynamic expressions. Whereas painting, and oil painting in particular, can be considered to be an advanced artistic medium that 500 years after its invention still captures our attention and interest, it is as a media primarily bound to static, physically inert works of art. Digital technologies bring a new dimension into artistic

expressions in that the work of art now can change, move and become physically interactive in relation to the user. That is why this research has chosen to focus on media art. Hence less attention is given to immersive, painterly expressions like Mark Rothko's '*Rothko Chapel*'. Much like immersive, digital technologies this work intends to create a total experience of art through 'consummated experience between picture and onlooker' (Baal-Teshuva, 2003:7), but differs in its static expression.

The concept of the digital is often understood in some kind of opposition to 'analogue' or classical visual art (Weibel, 1984). It is almost a Platonic dualism (Blachowicz, 1998:154) where the number-based digital technologies have come to be associated with adjectives such as 'pure', 'clean' and 'perfect' due to their almost faultless reproduction. As analogue technologies rely on translation between media it is more likely to produce faults and glitches (Butler, 2002:207). The term analogue is therefore often associated with the faulty and imperfect. There is, however, always some analogue component present in digital art. That can be anything from an 'analogue' switch to a lighting system to loudspeakers to the human user.

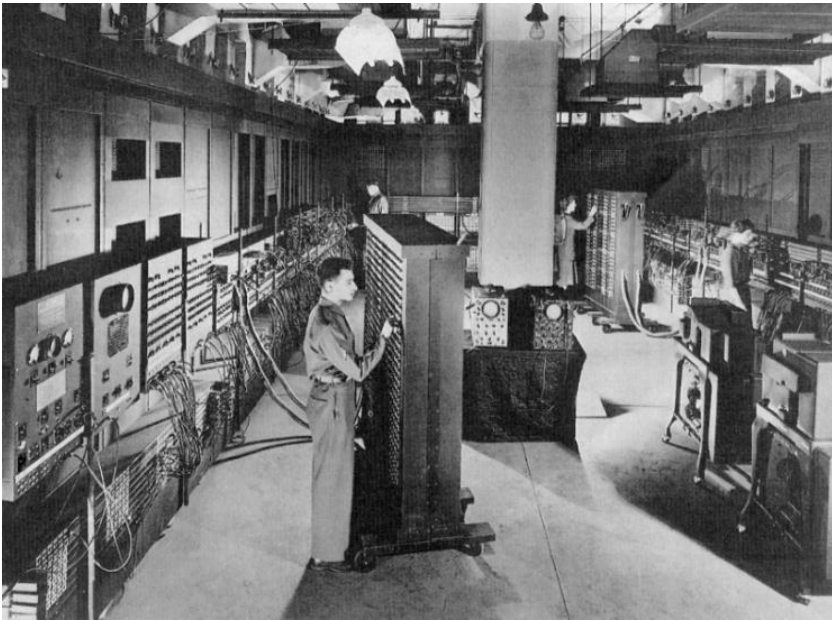


Figure 4-1 The very beginning of digital art: the Eniac computer at work in 1946 (photo from Wikimedia commons).

Touch in particular is an embodied and 'analogue' experience. As seen in psychophysics, it brings forth quite different experiences according to the media and the situation the user is in. Whether one understands touch to be

‘impure’ or not, it represents an interesting ‘human’ bridge between the digital and analogue domain. With these points in mind it is useful to describe some of the most important milestones out of which the digital art field has emerged. Digital Art has a relatively short history. As the name implies, it was first possible to make it when the digital technology was developed and available. That happened at the advent of the first digital computer, the ENIAC (Electronic Numerical Integrator and Computer) in 1946 (Paul, 2003:9). This points to the technological reliance and technological basis of digital art. It is strongly related to—or even dependant on— industrial developments like the microprocessor, system software makers like Microsoft and Apple and, not to forget, designer paradigms/limitations given by programs such as Adobe Photoshop and Flash. The contingency of particular developments in digital hardware and software have in part influenced what kind of art experimentation and experience can take place (Hillis, 1999:30). This raises the question if digital art is limited by technological determinacy? The history of the digital technologies of touch is perhaps too nascent for any ruling paradigms to have developed. There is still too little technology, too few applications and experiences available. Other reasons why a cultural demand for haptic entertainment has not developed can partly be because touch is such an unspecific and uncontrollable sense to use for defined applications, but also because the available technology like force feedback devices – joysticks, wheels, controllers – have been a too imprecise and unreliable technology.

Returning to the origin of digital expressions, how did we go from the worker who manually switched cables on the almost non-visual ENIAC to what is popularly called *cyberspace*: ‘a globally networked, computer sustained, computer-accessed, multidimensional, artificial or ‘virtual reality’” (Benedikt in Hillis, 1999:1)? In its historical narrative part, digital art can be seen as going a long way back. In her book *Computers As Theatre*, Brenda Laurel comments on digital storytelling:

Enactments around prehistoric campfires, Greek theatre, and performance rituals of aboriginal people the world over are all aimed at the same goal: Heightened experience through multisensory representation (Laurel, 1993:187).

The development of multimodal digital art can therefore be seen as a natural expansion of an innate, human inclination to dramatize and tell exciting stories. One difference was that before the storytelling happened around the body, now –through haptic technologies- it can happen *on* and *through* the body.

Inspirations for digital art like immersive spaces and virtual realities can be traced a long way back in fiction, fantasy, alchemy, poetry and art. In Antiquity there was a strong tradition of painting image spaces of illusion. This we find, for example, in the cult frescos at the *Villa dei Misteri* in Pompeii (Grau, 2003:5). Oliver Grau sees the mentally absorbing process of immersive experience as the key to understand how media has developed (Grau, 2003:13). According to him, the history of immersion goes back at least to the mentioned frescos of the Roman Republic. Its artists brought out wall paintings that ‘draw the visitor’s gaze into the painting, blurring distinctions between real space and image space’ (ibid, p. 25). The visionary American thinker Howard Rheingold (1991:379) goes back to Lascaux and sees those murals as a magic theatre of the senses.³⁶



Figure 4-2 Fresco from the Sala di Grande Dipinto, Scenes in the Villa de Misteri (Pompeii).

Photo: Wolfgang Rieger/ Wikimedia commons.

The ability to reproduce landscapes in an ultra-realistic manner came with the invention of the *camera obscura*. This is generally attributed to Giovan Battista della Porta (Jütte, 2005:190). In a portable version it enabled artists to make photographic like reproductions of landscapes, further contributing to the art of making immersion possible. The next contribution to developing techniques of immersion came with the panoramas. These were large rooms or even buildings dedicated to one massive and 360 degrees circular painting of a specific and illusionistic landscape. The viewers would see the painting from an appointed point of view in the middle of the room (Grau, 2003:56 and Jütte, 2005:194). The paintings usually depicted famous places or historical happenings such as battle scenes. As such it becomes clearer that immersion is also about creating a ‘*Gesamtkunstwerk*’, a total work of art where all the senses of the visitors are led to believe they are perceptually and actually ‘elsewhere’ whilst they are actually at ‘home’.

³⁶ For online view of the caves: http://www.lascaux.culture.fr/#/fr/02_00.xml

As Robert Jütte remarks in his book *A History of the Senses: From Antiquity to Cyberspace* (2005), human spatio-temporal consciousness was altered by technologies as early as the nineteenth-century. Not only did the wireless telegraph and the telephone let people have the first taste of real-time telepresence, but they also became so popular that telephone poles and wires disfigured townscapes. This demonstrates how quickly the public appetite for telepresence grew. Further it is a possible indication of how fast a future, immersive, haptic technology might grow if it adds functionality and depth to a cultural desire for new, telepresent technologies.

Whether a technology catches on or not, depends not just on the technical functionality, but just as well on a social and cultural demand. In his book *Deep Time of Media*, Siegfried Zielinski (2006) defines and describes the field of media archaeology. He depicts the history of media in a longer perspective and goes two thousand years back in his attempt to trace and understand the media of today. According to him, this development does not necessarily progress linearly, from primitive tools to more complex technologies. Media development is a fractured process often accelerating intensely during certain periods of time and frequently ending without success or break-through. The development from storytelling around campfires to cyberspace can be told as a natural, almost linear process, even if in reality it is not quite so simple. The *Dead Media* Project has long lists of all the strange, weird and finally useless technologies that have been invented. As Bruce Sterling writes on *Dead Media*: ‘*we need a book about the failures of media, the collapses of media, the supercessions of media, the strangulations of media, ... all the freakish and hideous media mistakes that we should know enough now not to repeat, ... media that didn’t make it, martyred media, dead media*’.³⁷ That does not mean that all the historical media failures were necessarily futile or sacrifices to some kind of media-darwinism. This process with all its small deaths and some fantastically weird experiments can –according to Zielinski- also shed light on the future of media development. We must expect the list of dead technologies at *Dead Media* to grow a lot bigger. And why not? As Zielinski writes: ‘*Media are spaces of action for constructed attempts to connect what is separated*’ (2006). This statement underlines the high level of experimentation and many zones of creative construction so often found in media in general and digital art practice in particular. One of these construction zones might tell a better haptic story that evokes the same interest as telepresence. Currently it appears as if most of the state art of haptic technologies belong to the *Dead Media* list.

³⁷ www.deadmedia.org accessed June 2008.

Let us return to the interesting predecessors of multimodal, digital expressions: in Enrico Prampolini's manifesto on *Futurist scenography* (1915) he called for the replacement of traditional scenography by dynamic electromechanical scenic architecture of luminous elements in motion (Grau 2003). He wanted new and grand worlds for theatrical magic and technique'. This was continued in Kurt Schwitters demand for his 'Merz' theatre in 1919 (ibid, p. 145) that would realize his vision of the Gesamtkunstwerk, as mentioned above: a total work of art. A third example is Walter Gropius vision for a '*Totaltheater*'.³⁸ The influences of experimental theatre on the development of multisensory expressions are interesting to the development of VR, but it is beyond the scope of this thesis to go more in depth here. Another historical 'missing link' that marks the development of immersive technologies is the works on early flight simulation from the 1930s onwards. Soon after the ENIAC computer was built it was realized that it might also deliver the advanced computation necessary for simulating flight (Hillis, 1999:3).

These examples have in common their movement towards using complex, 'multisensory representation' grounded in user presence and in the user's body. This tendency is relevant to the historical expansion of mainly audio-visual-based immersion and digital art technologies to include other sensory channels. These historical developments hint at future that will expand the repertoire of media and expressions available. To expect an inclusion of new interface technologies, inclusive of the haptic domain, is natural and perhaps even to be expected.

Works of art using technology to produce haptic and touch experiences are uncommon, but also have their history. In 1921 the futurist *Marinetti* produced an essay on '*tactilism*' where he described the various values he associates with tactile sensations (Classen, 2005:308). With this tactile 'vocabulary' he produced 'the first abstract suggestive table'. What is interesting about this work is how the tactile sensations can be imbued with symbolic values. As Classen observes, this points towards the day when touch comes into its own, and 'the hands can be as knowing as the brain' (Classen, 2005:309). What if we could be present in a different space and experience it as if we were really there? This question has triggered much imagination and inspired several technological inventions. One of the first was the field of telepresence.

³⁸ Translated to English it would mean something like 'total theater' in the sense of a 'complete sensory theater experience'.

4.2. TELEPRESENCE

The advent of the telegraph and the telephone was perceived as magic at the time (Munro, 2008:164) and triggered a long range of discussions as well as future oriented thinking.

Telepresence can be defined as a clear sensation of being physically present at a physically remote location or environment (Hillis, 1999:182; Paterson, 2007:127; Grau, 2003:271). It is a quite specific communication technology in need of real time interactivity and a minimum of network latency. Historically its roots go longer back than digital art and there is a history of the development of increasing presence over time.

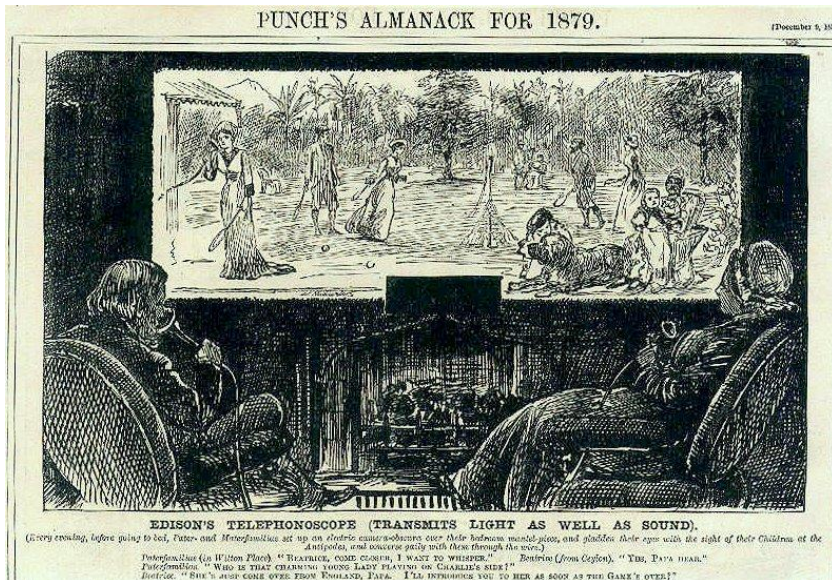


Figure 4-3 Edison's Telephonoscope. Illustration George du Maurier / Wikimedia commons.

An early magic dream of reaching out and connecting to the corporeal at distance is illustrated by Edison's vision for the Telephonoscope from 1878 where two distant places are connected through sound and images.

The phenomena of sensory connectivity over distance later came to be known as telepresence. It described the audio-visual potential of real time exchange of visuals and sound. In the 1950s this became known as video telephony as AT&T in 1956 builds the first Picturephone test system. The novelty in the Picturephone was the implementation of two-way audio-visual communication. It was the first multimodal communication system enabling a real-time connection over a dual channel sensory system, that included both sound and moving image. But are those two channels enough to really feel one is translocated or present at the other end of the line? When AT&T

launched the Picturephone at the 1964 New York World Fair it was said it would ‘displace today’s means of communication’ by the end of the century. Physical presence would be realized through Picturephone’s ability to convey a ‘*feeling of proximity and intimacy with the other party*’ (Lipartito, 2003). In spite of the high hopes for a commercial success of the video phone, this never happened. Until the introduction of free Internet systems like Skype, videophones have suffered from poor resolution, time lags between voice and image, not to mention the heavy costs and complex technical infrastructure as well as set-up needed. From the user’s perspective, unless the participants sat still in front of the camera, one would more often than not see chopped off heads or boring backgrounds like office interiors (Dutton in Emmot, 1995:97). In short, videophones do not necessarily give a good enough feeling of *being there*. It gives some sense of being there, but does not appear to have the necessary added value to replace, for example, single channel, voice-based communication. So why is multimodal videophoning not necessarily better than phoning alone? Cisco’s recent advert for their TelePresence videoconferencing system presents many of the illusions and possibilities of video-based telepresence. Their commercial ‘Town Square’ video³⁹ shows a giant video wall connecting two town square in what appears to be Italy and China. It conveys the ultimate promise of how video can let users feel the presence of remote locations/communications. According to the Cisco advert the system offers ultra-high video resolution revealing subtle facial expressions, spatial audio transmission every nuance of the conversation, an optimized environment for a comfortable and enhanced meeting experience and, finally, communication and interaction in real time as if no screen was present. Whereas this sounds good, it repeats all the mistakes of the initial systems from the 1960s. The 2009 version appears a little better, but not fundamentally different. The promises of ‘*being there*’ have still not been met.⁴⁰ The problem of videobased telepresence is that it tries too hard to reproduce reality as it appears face-to-face between humans. By trying to reproduce that situation through sound and video, video-based telepresence neglects many of the important issues of haptic sensation so necessary to get a sense of ‘being there’. The vestibular system with its sense of orientation is hardly stimulated. One example is the challenge to recognize what is ‘north, south, east and west’ when the camera moves around? Despite Cisco’s promises they have a real problem of sensory resolution. Another example is the High Definition video resolution of 2K⁴¹ which is still poor compared to the more than 100K (100 million) pixel optical resolution of the

³⁹ <http://www.youtube.com/watch?v=Zmqva2rkVXA> accessed on November 24th 2009.

⁴⁰ John Thackara on telepresence: http://www.adobe.com/uk/designcenter/thinktank/tt_thackara.html accessed on April 5th 2010.

⁴¹ 2K = two million

eye. Sound must be reproduced through static loudspeakers and there is complete absence of real-world clues like smell. Videobased presence is essentially a flat representation of a world rich on sensory perceptions, and it does not manage to trick our senses and create what the poet Coleridge famously called a '*willing suspension of disbelief*': '*Poetic faith in persons and characters supernatural or at least romantic ... a transfer from our inward nature a human interest and a semblance of truth sufficient to procure for these shadows of imagination that willing suspension of disbelief for the moment, which constitutes poetic faith*' (Ferri, 2007:ix). With this he meant that we are willing to understand an obvious simulation as real provided the right clues are present. In theatre we willingly give up the real setting of the passive, frontally positioned audience, artificial lighting, overdramatically dressed and made up actors to believe in the experience. Similarly, one reason why participants of my cyberSM project found it so real was that it created a staged theatre for the senses that did not try to be photorealistic. It did not try to recreate a specific, holographically real representation of others. Instead selective and blurred impressions of a body allowed the participants to fill in the missing gaps and expand the experience with their imagination and fantasy. The user is engaged in the co-construction of the fantasy, and this can be on a continuum of verisimilitude. Here touch became a factor adding meaning to the perceptibly artificial experience and made a vibromechanical touch believably and humanly real. Urmson argues that there is rarely a genuine illusion experienced in theatre as an audience then most likely would phone the police every time a criminal act was performed on stage, thus making theatrical acting impossible (Marinis, 1993:154). As multimodal media develops, one question relevant for this thesis is how the addition of touch affects our willingness to a suspension of disbelief. Even if videophoning software does not do it, there are examples of artistic works using the same technology that let users feel as though they are touched. Installations like Paul Sermon's '*Telematic Dreaming*' (section 4.7.2) use psychophysical techniques to induce this in users. The installation is not using 'photorealism', but cause a sensory displacement due to it being a convincing enough illusion. This is an example of how artistic works expand on standard technologies to create different experiences and sensations. The next section will look at other examples.

4.3. A SHORTER TAXONOMY OF DIGITAL ART

If the cultural origin of digital art goes a long way back, then its technological history is all the shorter, stemming from the Eniac computer in 1946 at the earliest. According to Matthias Weiss the technological development that led to digital art can be divided into three phases, of which this thesis is primarily concerned with the third (Weiss, 2004). The early first

phase was occupied with practical aesthetics of making graphics. This ‘first’ phase of digital art appeared in the 1960s and initial projects were focused on making computer drawn graphics. Bell Labs were early developers in this field. Michael A. Noll, one of their researchers, exhibited at the 1965 ‘Computer-Generated Pictures’ show at the Howard Wise Gallery in New York (Paul, 2003:15). What enabled the use of computers to make graphics were inventions such as Ivan E. Sutherlands ‘sketchpad’ project, the first graphical user interface which enabled the users to draw directly on the monitor with a hand held light pen (Grau, 2003:162). The second phase was with video. As the computing power increased, the third phase of real-time simulation emerged. This enabled the construction of responsive, immersive environments and Virtual Realities. Whether we follow this three-part taxonomy or not, one factor that enabled multi sensory immersion was the close relationship that emerged between video, display- and projection technologies and early computer graphics.

4.3.1. Digital and interactive video: Krueger’s Videoplace

In the seventies and eighties digital art developed towards video-based expressions and installations. In the mid 1970s Myron Krueger developed his first computer-based responsive environments ‘*Videoplace*’ (Grau, 2003:166).



Figure 4-4 Screenshots from Krueger’s Videoplace installation. © Myron Krueger.

Krueger has since developed this installation into several versions. The basic set up is a two user situation, each in a separate room. Each has a projection screen and a video camera in front of them. The camera captures the user’s movement and the live video is then fed to a special hardware system that transferred the users into silhouette representations on screen. Krueger later developed his own real-time image recognition and image analysis computer system. On the screen the users were then able to communicate through their projected images in a ‘shared space’, i.e. same video image (Gorayska, 1996:134).⁴² The interaction with on-screen objects and other users reportedly led to a relatively believable sense of ‘presence’ in the sense of

⁴² Also see <http://www.medienkunstnetz.de/works/videoplace/> accessed April 6th 2010.

being a part of the action and having direct and immediate feedback. He described this responsive environment as '*the basis for a new aesthetic medium-based on real-time interaction between men and machines*' (Wardrip-Fruin, 2003:390). The environment was made believable, not because of photorealism, but -similar to 'Telematic Dreaming'- through convincing-enough illusion due to video superposition.

This was the creation of what he called an artificial reality. Such 'realities' surrounded the users, and responded to their movements and actions, without having to use or be inhibited by the use of goggles or gloves.⁴³ This is well described in Krueger's book '*Artificial Reality*' (1983). Within the 'artificial reality' of the responsive environments his 'goal was full-body participation in computer events that were so compelling that they would be accepted as real experience' (Krueger, 1991). There was no direct tactile feedback available, but through real time, interactive images *Videoplace* apparently tricked the users into perceiving some kind of 'touch'. Even if this installation is a highly interactive, sensorial rich and immersive environment (Laurel, 2003) and a forerunner to the later development of virtual realities, it is a second phase digital video art project.

Videoplace is a predecessor to later media art works like 'Telematic Dreaming'. In the case of *Videoplace*, it is such an important piece in the development of media art because it involves the haptic senses of movement and embodied presence to control screen-based interaction. It represents a big step towards multisensorial and embodied interactive systems that involve more than vision and sound. Both projects involve a visual and shared space of communication. They both involve the users' haptic senses, but as will be discussed in section 4.7.2, most importantly seem to cause haptic sensations in their use of video superposition.

Another interesting statement arising from Krueger's work on digital art is his focus on adapting technology to the human, and not the other way round. Thus his statement '*that the ultimate interface between the computer and people would be to the human body and human sense*' (Krueger in Hillis, 1999:6 and Gorayska, 1996:130).

4.3.2. Real time simulation and the beginning of cyberspace

What Weiss called the third phase of real time simulations later became known as Virtual Realities. It is highly relevant to the development and use of haptic technologies not just because it created a demand for faster and better computers, but because as the media theorist Achim Bühl describes it, its computer-generated world '*engages several human senses simultaneously, ... giving the user the impression that the computer-generated environment is*

⁴³ <http://en.wikipedia.org/wiki/Videoplace> accessed April 6th 2010.

actually real’ (in Jütte, 2005:327 and Paterson, 2007:118). It appears that immersive visualization technologies give users the impression of being touched. The impression of being touched by sight is discussed by Paterson (2007:55). Such impressions are likely to influence a wish for actually and physically being touched.

This VR phase was triggered by cheaper and faster computer technologies in the late 1980s and early 1990s, but began with the early flight simulators built on the ENIAC computer. The cultural development of Virtual Realities may be historically in debt to a much longer tradition, but the important technological birthmark was in 1966 when Ivan Sutherland developed the first *HMD*, Head Mount Display, for images and in 1968 for real-time computer graphics (Grau, 2003:163 and National Research Council, 1999). These binocular looking devices gives the user a stereoscopic, three dimensional impression of images and is still one of the best ways of achieving visual immersion inside image-based worlds. In combination with a three dimensional, position-sensing tracker system to monitor head movements, the computer can output images according to the body movements and gaze of the user, thereby perfecting the illusion of ‘being there’ inside the virtual and simulated world.

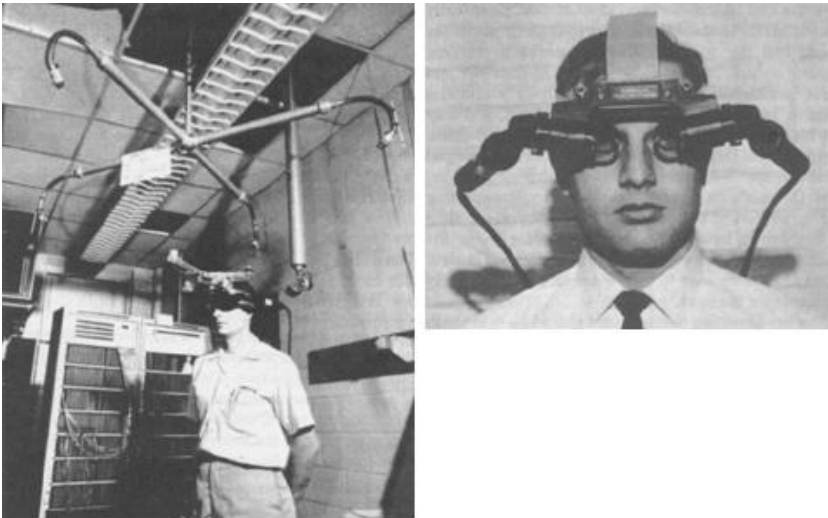


Figure 4-5 Sutherlands first Head Mount Display from 1966, the so called ‘Sword of Damocles’ (Sutherland, 1968).

Immersion hence implies that the user is encompassed by an interactive, real-time, 3D computer-constructed and controlled environment whereby he or she forgets the gap between the virtual and 'real', physical reality.

This technology was further developed by NASA and VPL (Visual Programming Language) and VPL's Jaron Lanier also gave this the term Virtual Reality in 1989 (Grau 2003). The first breakthrough of VR came that year when VPL built the first commercially available head mount display VR systems (Laurel, 1993). The term VR now describes a whole range of 3D computer-environments: websites, virtual worlds like 2nd Life, Quick Time VR movies, VRML (Virtual Reality Modelling Language), CAVE systems with three and more projection screens, gaming consoles & environments and Augmented Realities that overlay real images with virtual data. VR takes place in what William Gibson coined *cyberspace* in his 1984 book *Neuromancer*:

Cyberspace. A consensual hallucination experienced daily by billions legitimate operators, in every nation, by children being taught mathematical concepts... A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding...

The first directly relevant technology to enable touch in computer enabled environments came when Thomas Zimmerman invented the prototype of the dataglove in 1981 (Grau, 2003:167 and Hillis, 1999:14). This glove is built around optical fibers that run along the fingers. When the user bends the fingers the flow of light is inhibited and the movements and gesturing of the hand can be calculated. The device enables the user to command and communicate with the system through the use of finger movements and symbols. Hereby the user can also touch and move computer-generated objects with the glove. This helped to spawn the image of VR as a 'real', physical reality. It also brought closer the vision of a telepresent technology that lets us 'be there' on the other side of the communication line a step closer to reality - even if these first steps incorporated only tracking of the body and completely lacked haptic feedback. Even so they are of interest to the development of touch in connection to virtual reality technologies.

4.3.3. Adding touch to telepresence

The development of the physically distinct telepresent sensations Edison imagined in the Telephonoscope has taken a longer time. In 1990, Howard Rheingold described the physical cybersexual VR system of the future.

Rheingold's visions were inspired by the images of NASA and VPL's HMD and bodysuit. He imagined a user wearing a smart datasuit that registers all the body's movements and senses, converts them to signals that enable other users to feel him/her and vice-versa. This made him coin the term *teledildonics*, the technology that enables humans to have sex in virtual reality:

Now, imagine plugging your whole sound-sight-touch telepresence system into the telephone network. You see a lifelike but totally artificial visual representation of your own body and of your partner's.



Figure 4-6 The NASA HMD by Scott Fisher, the so called VIEW (Virtual Interface Environmental Workstation). Image courtesy of Scott Fisher, NASA-Ames Research Center.

The above illustration of the NASA '*VIEW*' HMD is perhaps just as interesting from a sociological point of view as from a technological. The technology was perceived as new, but was really an improvement of Sutherland's glasses 20 years earlier. However, what is interesting with the image above is the untold story of the role of touch in VR. The photo plays with the expectation of having a total immersion into a technology –and therefore supposedly 'free' and 'magic' experience. The gloves on the hands

indicate that anything inside the VR world can be touched and manipulated. In reality there were no tactile feedback or experience. Objects would for example not have any weight or tactile texture. The woman's hair blowing in the 'wind' adds even more to the impression of her having a strong corporeal experience. The HMD image was not taken during use, but was a documentation of a fake experience within VR. The female model in the photo was instructed to act as if she experienced 'wind'. The fake story told by this and similar images triggered a cultural impression of VR's unlimited possibilities for corporeal experiences. It was as if real time visual computing suddenly enabled users to touch and being touched. Other projects did not take this short cut and Morton Heilig actually applied 'wind' through the use of an airfan in his *Sensorama* project (section 4.5.2).

The historical developments had by the end of the 1980s led to a ripening of real technologies such as Sutherland's display, the dataglove and advanced real-time graphics. They were made into commercially available products. In combination with visionary thinkers like Rheingold and NASA's publicity this sparked the media revolution and fuelled the enormous hype of VR in the early and mid 1990s. As the haptics technology was underdeveloped or simply missing, users did not corporeally experience the hype as promised and the belief in VR as corporeal 'reality' has since faded.

On the other hand, the ripening of computing speed, display- and tracking technology now gave users access to the three elements Michal Heim saw as the building blocks of VR: the three I's of immersion, interactivity and information density (Heim, 1998:7). This triangulation was slightly modified by Burdea and Coiffet that named their version of the three I's: Immersion, Interaction and Imagination (Burdea and Coiffet, 2003:3). As the NASA image shows, imagination was indeed a central component in building a culture around VR. Imagination also fueled the vision of full body immersion in artificial worlds.

4 . 4 . I M M E R S I O N

Immersion is a term with several and often unclear meanings. Most often it is used to describe either technologies or the effects of applications/experiences. Immersive technologies manipulate our perception in such a way that users feel they are surrounded by an artificial, hyper-real world (Emmot, 1995:61). As an application/experience, immersion is an effect of media. One can be immersed in many media expressions ranging from a good story (Laurel 1993), listening to radio⁴⁴, seeing a film to 3D gameplay. One distinction between, for example, immersion and telepresence is that immersion is possibly an effect of telepresence technologies. The subjective sense of

⁴⁴ The radio broadcast of Orson Wells 'The War of the Worlds' in 1938 caused mass panic.

immersion is a good measure of how real an experience might feel. This is in line with the understanding of immersion from a phenomenological point of view as: *‘the sense of presence through which the user feels corporeally connected to the world’* (Ryan, 2001:14).

4.4.1. Taxonomy of haptic immersion

Sherman and Craig (2003:381) point to two kinds of immersion: the mental and the physical (sensory). Relevant for this research is the physical experience of immersion. Several kinds of *haptic immersion* –as the experience of haptic impressions due to immersion- can involve the physical body, both in terms of technology and experience. A simple and initial typology of somatic immersion according to media and relevant for my practice-based experiment is the tripartite division into *visual*, *aural* and *tactile* immersion.

Visual immersion as in Myron Krueger’s *Videoplace* and Paul Sermons videophone installation *‘Telematic Dreaming’* (section 4.7.2) creates sensations of presence with others, immersion in the story and phantom sensations of touch (Classen, 2005:439). Vision can in itself create sensations of touch (Paterson, 2007:56). As mentioned on vision-touch synaesthesia (section 3.3.1 and section 6.8.1), a general sensation of haptic immersion can be caused by visual impressions similar to the haptic imagery in cinema (Marks, 2002). Also, the example of Olafur Eliasson’s *Weather Project* (section 2.3.4) shows how an immersive physical environment can affect users to sense a general haptic stimulation. Cross-modal transfers from vision to touch is exemplified here. In the right combination, haptic vision without real physical stimuli can enhance the somatic sensations and sense of immersion. So called *‘haptic images’* encourage a bodily relationship between the image and the viewer (Marks, 2002:3 and 2000:129). Touch can be multisensorily experienced and cinema can visually produce sensory impressions of both touch and smell.

Sound immersion is often encountered and are fairly easy to produce due to the physically measurably effect sound waves have on our bodies. Therefore even deaf people can enjoy sound (Denmark, 1994). One historic example is the *Philips Pavilion* at the Brussels World’s Fair in 1958. It was designed in large part by Iannis Xenakis, at the time one of Le Corbusier’s architectural assistants. The program in the pavilion consisted of Edgard Varèse’s *Poème Electronique* played through 400 loudspeakers, projected images and coloured lights created by Le Corbusier. Iannis Xenakis’ *Concrète PH* played as an interlude between shows. The technical set-up was enormous and must have immersed and affected users physically through the physically measurable strength of the sound waves. Varèse described the sound to follow paths through the loudspeaker arrays, and groups of speakers

were used to create effects such as reverberation. He said, '*I heard my music literally projected into space*'.⁴⁵ A modern version of complete immersion into sound is represented in binaural recordings. This technique records and reproduces sound as it is heard naturally by the ear. Good binaural recordings gives the sound of 'being there', providing a strong impression of space and presence (Dodsworth, 1998).

Tactile immersion is hard to produce. Immersion through technologically induced tactile manipulation of the senses is rare in digital art. Some of the more important projects will be discussed later in this chapter. The tactile immersion encountered can be divided into either a general haptic sensation caused by immersive environments and cross-modal synaesthesia or a specific vibrotactile stimulation of the users as through bodysuits. Lindeman et al.'s research (2004) on full-body haptic feedback through applications made with their *TactaVest* haptic feedback system attempts to complete the user's sense of tactile immersion in a VR-based environment.



Figure 4-7 The back side of the TactaVest with effector/tactor Locations Marked. © Robert W. Lindeman.

⁴⁵ An MP3 excerpt can be found at: <http://emfinstitute.emf.org/exhibits/varesepoeme.html>, accessed on March 2nd 2010.

To produce haptic immersion and direct body manipulations they apply what they call ‘Tactors’. In my own work I have called these haptic output devices *effectors* (see section 4.8.2 on haptic hardware/cyberSM). Often these are based on vibrotactile stimulation, but can also be constructed based on devices such as pager/vibration motors, solenoids and small air fans. Lindeman et al.’s research points to many common difficulties in producing immersive haptic experiences. Difficulties to be overcome are wearability problems such as fitting problems of interface/suit, restriction of movement and vibrotactile stimuli with a poor range/expressivity.

4.4.2. Discussion on immersion

The theoretical tradition that is strongest in the practical field of designing human-computer interaction systems is the HCI (Human-Computer-Interface) (Dourish, 2004:73; Monk and Gilbert, 1995). Presence research is a recent development, springing from the HCI tradition. There are many cross sections and co-developments between HCI and the media arts, but again, the focus here is on the experimental field of media arts.

The development of digital art has for the most part been focused on two-channel, audio-visual sensory output. In the first three phases of development there has been relatively little focus on touch and haptics. Krueger wanted his responsive environments to be felt as real experience. Unique for his early approach was the way the user had to use his whole body inside the installation. It was a body-based interaction. However, there was no actual and physical touching going on. All touch was visual, seen on screen and made through video keying. It represents a haptic system indirectly involving several haptic senses, but not tactile touch.

Even if it is a growing field, touch is still a relatively under-used sense modality in digital art installations. One reason for this has to do with usability issues such as lower technical durability and lifetime expectancy. Things that are touched, pressed and squeezed have a tendency of breaking down more easily compared to a projection surface. The lack of haptic touch in digital art is partially due to the dependence of digital art on industrial developments. When technologies are getting smaller, cheaper, more mobile and more user-oriented, artists can be expected to appropriate, hack and use the hardware of industry to make new artistic applications. One example of this approach is the project ‘*Can You See Me Now?*’ by the English art collective *Blast Theory* (Bentkowska-Kafel; Cashen and Gardiner, 2009:79). Here the artists hack off-the-shelf portable electronic devices such as mobile phones, GPS, wireless LANs and digital cameras, equip a group of users with the gear and track them both in virtual and real space with their own radio-based tracker-system hack. Such *augmented* or *mixed* reality projects use touch and movement in interesting ways to achieve immersion in narrative.

They also illustrate Brenda Laurel's (1993) point that humans tend to tell stories in a multisensory way (section 4.1). This is a pointer to how multiple sense experiences can contribute to the heightening of an art experience. A possible *fourth phase* in the history of digital art would therefore be the addition of 'analogue', body-centred systems reaching out of the screen and into the multisensory domain. Touch and haptics would be natural elements of this fourth phase technologies.

Utilizing user's presence through tracking their body as input is more common than using active touch to stimulate the bodies of users. There is a range of art and sensor systems built that track and react through the user's motion, gesture, gaze, manipulation and activated objects (Stephen Wilson, 2002). This is both due to the miniaturization of technology as well as the drift towards mobile and wireless computing. This development points again towards the fourth phase digital art: works-based on transparent, mobile, body-based and individualized computing.

The history of immersion is also one about failures, as in the failing attempt to include smell. Projects like *Sens'o'rama*, *Smell'O'rama*, *Smell'O'Vision*, *O'dorama*, *Ismell* and others never quite made it (Paterson in Drobnick, 2006:359). Here, as for most technologies, dead or not, the problem of implementation lies not necessarily in the failure of the technology available, but in the cultural attitude (Paterson in Drobnick, 2006:366) and the question whether users want it or not.

4.4.3. The material paradox of virtual realities

In everyday life experience cannot always be broken down into separate experiences and the interpretation of commonsensical experience is not always correct. One example is how virtual reality often has been thought of as being immaterial. Thinking of common day virtual worlds as everything from 3D computer games on the desktop pc to immersive CAVE systems⁴⁶, most users would probably explain the so called virtual reality to actually being somehow an immaterial state of existence. The images of elaborate 3D worlds as in the *Call of Duty* game series⁴⁷ look amazingly real, but can be found nowhere except in software and on the screen. Telepresence installations have therefore been understood as immaterial experiences. Consequently artists like Eduardo Kac have talked about an immaterial art (Kac, 2005:156).

Virtual Realities and telepresence can be experienced as if they really do not exist. This is not so. Virtual worlds do physically exist. If not as really real worlds, at least as physically and electronically measurable phenomena. Everything that can be experienced around a computer is the result of some

⁴⁶ <http://www.evl.uic.edu/core.php?mod=4&type=1&indi=161> accessed on March 20th 2010.

⁴⁷ <http://www.callofduty.com/> and http://en.wikipedia.org/wiki/Call_of_Duty accessed on March 20th 2010.

physical conditions. A virtual image is not a product of magic, but a rapid succession of electrical signals produced, sent and decoded by various electrical components. This is also recognized by Kac who says that *'immaterial art does not mean art without any physical substrates; rather, it signifies the exploration of televirtual domains and the foregrounding of the participants experience'* (ibid, p. 156). Another element is the narrative and believability of a virtual world, whether it has lifelike consistency and meaningful cause and effect. Due to the missing history of touch and corporeal experience such as weight in the history of VR, it would be more appropriate to call VR for *Visual Reality*. The addition of corporeality to multimodal environments will be further discussed in chapter six.

When I curated the travelling electronic art exhibition DETOX⁴⁸ in 1999 we measured the weight of the equipment. This interactive media art exhibition had a total weight of eight tons. Many people were stunned when they heard this. One reason for this is that we live in a culture that shares a common hallucination, namely the understanding of electronic media as something weightless. It is 'virtual', as if it is immaterial and spiritual. These 'magic', 'virtual' bits appear on screen, telling us stories, letting us hear sounds and see images live from other ends of the world, getting us in touch with other humans in a split second, so that, as Clarke indicates at the beginning of this chapter, perhaps the virtual is indistinguishable from magic. It is significant to bear in mind that these 'magic' bits are very real. And they consume power too. It is estimated that a single Google search costs as much energy as an 11 W bulb needs to light a room for one hour.⁴⁹ The material paradox of virtual realities is that it is very material indeed. One significant challenge is how to make computer based environments corporeally experiential through tangible and touching technology.

4.5. TOWARDS TANGIBLE AND TOUCHING TECHNOLOGIES

Haptics technologies enable a higher degree of sensory connection between man and machine. How can use this to both instrumentally master the real world and make 'magic' inspirations an experiential reality? Is it possible to use media technology to experience 'a freedom limited only by our imaginations' (Plant, 2007:180)? How to touch and be touched, across distance and dimensions, virtually as well as real? Does technology really make the 'magic' happen? This section will accordingly discuss the ubiquity of elementary force feedback and technological developments that are facilitating corporeal interaction and functionality.

⁴⁸ Produced by the norwegian Touring Exhibitions (Rikstutstillinger).

⁴⁹ Tagesschau, 4.3 2008, <http://www.tagesschau.de/inland/energieverbrauch2.html>, accessed on March 20th 2010.

In combination with the recent developments in wireless communication technologies, ubiquitous computing and multifunctional mobile phones, our everyday lives are increasingly merging with digital technologies. It is even symbiotic in as far as it renders the historical vision of the cyborg as represented by Donna Haraway in her *Cyborg Manifesto* (Haraway, 2004) and William Gibson in his '*Neuromancer*' (Gibson, 1984), practically possible. The cyborg can be defined as a functional symbiosis of man and machine. One artistic representation of the cyborg is that of the Australian artist Stelarc with his *Third Arm Project* (Wilson, 2002:159 and Smith, 2005:13). The functional implementation of 'cyborg technologies' is underway on a large scale with standardized and miniaturized technologies like the mobile phone. Desktop computing-based VR experiments of the 1990s as found in the pioneering works of Knowbotic Research⁵⁰, Stelarc, cyberSM and others, were confined to limited performance spaces.

Now mobile phones like the Iphone and Android based systems are so small they practically merge with the user. They also have become so fast that they function like mobile computers. These recent developments of the mobile phone industry can be seen as a paradigm shift in computing that shifts the focus towards functional, ubiquitous, body-based applications. Another convergence effect of the mobile phone and the computer is seen in the move towards body-based applications like GPS-based *Geotagging* that adds geographical identification metadata to various media.⁵¹ The high speed networks -like 4G- metaphorically and practically represent an invisible data field that facilitates body-based interaction, encouraging the importance of physically 'being there'. By adding location-based computing applications to real places one can add to the sense of *genius loci* - the spirit of the place as the architect Nordberg Schultz called it (Bonnes, 1995:163). The wearable technology of mobile phones now includes single channel vibrotactile feedback. Elementary force feedback has so become an ordinary experience for the many millions of mobile phone users. A question of interest here is what other kinds of touch phenomena such wearable, 'cyborg' technology can facilitate, both as ordinary and new forms of touch.

The computer is an enabling device. It is a tool that allows us to do and experience things previously barely imaginable. In that sense the first VR was poetry. Poetic words dream up landscapes and impossible situations. With VR technologies poetry can be realized as audio visual fantasies. Clarke's Third Law states that it is our imagination that is our limitation, rather than the impossibility of technological achievements (Dawkins, 2000:132). As in the legend of the Greek god Proteus, 'magic' is that which

⁵⁰ Like their immersive SMDK project: <http://www.krcf.org/krcfhome/SMDK/1smdk.htm> accessed April 22nd 2010.

⁵¹ <http://en.wikipedia.org/wiki/Geotagging> accessed June 14th 2010.

enables us to change form and abilities. The image of Proteus is a dream of not being limited and defined by 'real world' circumstances. In his book *TechGnosis* Erik Davis (1998) writes the '*secret history of the mystical impulses that continue to spark and sustain the Western world's obsession with technology*'. For him technology and 'magic' are two sides of the same coin. Without 'magic' dreams and visions we would have less technology. And progressively advanced technology possibly inspires us and inspire us to dream more 'magically'. As Sadie Plant above ironically comments on 'possibilities only limited by our imaginations', sufficiently advanced technology promises us the possibility of becoming one with our fantasy, just as in the early magic dream of reaching out and connecting to the real at a distance animated Edison's *Telephonoscope*. If we go beyond the fantasy, what about the *embodied*, corporeal experience of actually *being there*? What about reaching out and taking part in the *real* world game that Edison pictured? For the user's sense of being there is quintessential to enable the feeling of the 'magic' of sensing and acting and changing at distance. Such a factual sense of reality is still a dream. And without a physically sensing *telematic* body sensing over distance it will most likely not happen. Sound and image is too flat an experience to recreate reality at distance. Additional and haptic senses seem necessary to create an experience that is deeper and more immersive. Current haptic and tactile technologies provide some of the necessary solutions to build better 'magic', that is perceptually more convincing experiences through a more complete sensory immersion than the audio visual Picturephone. As a fairly young field of technological research and development, haptics contains much potential for 'magic'. However, as McLuhan's concept of hot (High Definition) and cool (Low Definition) media shows, more media is not always the right solution to engage users (Marchessault, 2005:176). In many situations -such as the 'cold' phone conversations- users are immersing themselves through the need to fill in gaps of information with their own fantasies. In this way Lo Fi (lower resolution) application can make experiences more intriguing compared to a high resolution Virtual World where there is less need for active participation. This conception of media underlines the importance of the content, the story and the context in which technological 'magic' is experienced. It is not just a matter of the technological fidelity⁵², but as discussed in chapter three also about the psychophysical set up. At the same time there is a haptic, perceptual threshold. For example the elementary force feedback from the one vibrator of current mobile phones appears too little to produce a wider range of 'haptic stories'.

⁵² Fidelity as in realism and/or accuracy of reproduction.

The general challenge for haptic touch technologies in computer based environments is to facilitate *how to feel something as something?* How do we for instance sense a cup inside a virtual world as a cup in Real Life (RL)? Or, if I want to open the door inside a 3D game, how do I know when I touch it? How does the cloth of my virtual dress feel – for real? What is the wind inside a virtual space like? And, not at least, how can I shape and express abstract emotions, like anger, sadness, and proximity through a combination of 3D visuals, sound and touch?

The remaining part of this chapter will give an overview of the field of tactile technologies, applications and research. There is comparatively little research and few available technologies in this field. Technological and western cultures are mainly focused on the audio visual experience and thereby forgetting or even actively writing out a culture of touch (Paterson 2007:59). Innovative touch technologies for the mass-market, such as Apples new range of touch-based interfaces, used in the iPad and Iphone, are gradually changing this. There are more touch interfaces now than before and they function better. Touch screens with high degree of usability and speed are replacing older button/interface systems as we know them from earlier mobile phones. These are now everyday technologies, but far from granting users ‘limitless possibilities’ and a freedom ‘only limited by our imaginations’. The next sections focus towards the user experience of tactile touch within immersive multisensory environments, and within media-art specifically.

4.5.1. Touch-related visions, inspirations and historical concepts

Psychology is the physics of virtual reality. -William Bricken.⁵³

Images of technology can inspire the development of real technologies. The sci-fi series Star Trek is said to have motivated the design of many current technologies, including the Tablet PC, the PDA, mobile phones, VR (Bell, 2006:86) and the MRI.⁵⁴ Haptic and multisensory systems can be traced a long way back in fiction and fantasy. Several of the significant images and visions on haptic technologies within popular culture, literature and film have had an impact on the way we think and act with technology.

In *Brave New World* (1932), Aldous Huxley described the *Feelies* – a future movie format that gives you a sense of touch in addition to seeing and hearing (Benyon, Turner and Turner, 2005:404). In the *Feelies* people would feel intensely part of the action, as when watching a couple on screen making

⁵³ SIGGRAPH Proceedings, 1990.

⁵⁴ http://en.wikipedia.org/wiki/Star_trek#Cultural_impact, accessed on March 2nd 2010.

love.⁵⁵ It remains unclear how this was to be technologically achieved, but the *Feelies* represent nonetheless a conceptual invention in terms of expanding audio visual representations with haptic sensations to create and tell a corporeally convincing story.

The *Excessive Machine* appears in the 1968 fantasy-sci-fi film *Barbarella*, starring Jane Fonda. Shaped like an organ for the body, the *Excessive Machine* is made to torture the user through over-stimuli of pleasures. Needless to say, Barbarella, the heroine, overcomes the machine as it breaks down because it cannot satisfy her libidinal needs.



Figure 4-8 The Excessive Machine from the movie *Barbarella*. ©

SimStim is a concept for haptic media that *William Gibson* described in his book *'Neuromancer'* (1984). *SimStim* is a portmanteau meaning simulated stimulation. The technology wires your brain and body directly to a pre-recording of another person's full sensory experience. Instead of seeing Britney Spears in concert you could, for example, experience being her, in her body, singing her songs, on stage, live. In Gibson's cyberpunk universe, the *SimStim* has become the entertainment medium and has replaced television. Similarly to TV it is also a one-way medium where one can only

⁵⁵ <http://www.huxley.net/studyaids/bnwbarron.html>, accessed on March 2nd 2010.

experience pre-recorded physical and emotional sensations of the *SimStim* stars.



Figure 4-9 The SQUID in action. Left image shows user, the right image the victim.

The *SQUID* device (Superconducting Quantum Interference Device) appears in the film *Strange Days* by James Cameron (story) and directed by Kathryn Bigelow. A hair-net like device is put on the subject/user's head. This minidisc-based system can both record the entire user's sensory experience as well as play it back, including onto the body of others. Through *SQUID* technology one gets a direct access to immediate sensations as if one really is the other person. It is a future model of Gibson's *SimStim* in that it is real-time playback. In the film this is a part of the main plot as one of the main characters is killing people with a *SQUID* on both his and the victim's head. In this way the killer enters the victim's body and can feel himself being killed by himself, an ultimate and repetitive suicidal process.

These four visionary and fictional projects all expand on the idea of VR technologies by adding haptic sense to the medium. The direct corporeal touch of the *Excessive Machine* is the crudest and most realistic idea of haptic technologies. Like my *Artgasm* project has shown, mechanical machines that physically induce orgasms can be built.⁵⁶ Other visions speculate about the idea that direct stimulation of the brain can produce full immersive haptic sensation. Such a mental-corporeal induction technology has not yet been realized. However, the other, direct physical approach is proven. Experiments with the human sensory system show that certain physical stimulations can trigger mental phenomena of being touched. One such phenomenon is the vibration-induced phantom illusions (Burrak and Brugger, 2005; Paterson, 2007:27; Lindeman et al, 2004) making users sense something that is physically not there. One example is the appearance of an object between the knees that is triggered when each knee is vibrotactually stimulated at a certain frequency. In our everyday use of technology this appears through the *phantom vibration syndrome*: 'You come armed with this template that leads you to be attentive to sensations that represent a cell phone vibrating,' Janata says. 'And it leads you to over-incorporate non-vibratory sensations and

⁵⁶ Performed in Beograd and Zagreb in 2008. See the *Artgasm* project description at my homepage: <http://www.stenslie.net/>.

*attribute them to the idea that you're receiving a phone call.*⁵⁷ This indicates how we experience *neuroplasticity* — the brain's ability to form new connections in response to changes in the environment.⁵⁸ This thesis has one focus on how effector and output technologies can mechanically stimulate the body, but the 'vibrator template' that Janata speaks of above, points to how other feelings and impressions might arise as an indirect consequence of effectors applied. This 'template' is also interesting as it indicates that a single vibrator can convey sophisticated and associative sensations. A question of interest for future research is therefore which phantom sensation of touch is produced by which stimuli.

These visions and ideas mentioned in this section have inspired my aesthetic agenda to use new media to realize the unreal. From an artistic point of view, the field of art is open, both to the most fantastically weird ideas as well as their technical realization. My first idea of haptic communication between two bodies in separate locations was later technologically realized in my 1993 cyberSM experiment, which is described at the end of the chapter. As Morton Heilig has shown, ideas of touch must not necessarily remain a dream of touch.

4.5.2. Sensorama: introducing practical haptics

One of the fundamental projects in the history of haptics and multisensory systems is the *Sensorama* project by Morton L. Heilig (1926-1997) (Grau, 2003:158; Kerckhove, 1997:90). It is an important project for the alternative haptic history of VR. Few people have tried the apparatus and it never became a commercial success, but it has become a reference projects for much research in this area.

⁵⁷ http://www.usatoday.com/news/health/2007-06-12-cellphones_N.htm accessed on November 25th 2009.

⁵⁸ Tactile Communication & Neurorehabilitation Laboratory at UW-Madison (TCNL) opened in 2008 and is dedicated to research on neuroplasticity, <http://tcnl.med.wisc.edu/home.php> accessed on November 25th 2009.

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Figure 4-10 The Sensorama system showing the user holding the shaking handlebars, sitting on the shaking seat and looking into the 3D projection box. © Morton L. Heilig.

The Sensorama is one of the earliest known examples of immersive, multi-sensory technology. It was invented and built by Morton Heilig who believed in expanding the 1950s concept of theatre and movies into something bigger. One of his aims was undoubtedly to make it corporeally encompassing and

thus let the user become a part of the screen. He called it ‘Experience Theater’. His vision of multi-sensory theater was described in a paper called ‘*The Cinema of the Future*’ (1955). The first functioning prototype was dubbed the Sensorama and came with five short films to be displayed/felt in it. Unlike today’s digital apparatus, the Sensorama was a mechanical device. The films shown inside have only been seen by a few, but according to Rheingold (1992), they were simple stories like a bicycle ride through Brooklyn or driving a motorbike down the road. The Sensorama displayed the films in wide angle, stereoscopic 3D images. In parallel it vibrated the users body through the shaking handle bars and seat, tilted the users body and also blew wind and aroma in the face of the user to provide ‘full sensory’ immersion. The goal of the project was to make you feel as if behind the screen and in the ‘real’ action it portrayed. Morton L. Heilig thought his project would even outdo the vision of Huxley’s ‘Feelies’, but the Sensorama never became a commercial success, and probably due to the complexity of the technology which would make it a costly system both to build and to maintain, especially when one considers it was made for only one user at a time. If it was to make money it would most likely be prohibitively expensive for every short ride. However, as a multisensory project it is recognized as an important conceptual contribution in the prehistory of multimodal Virtual Reality.⁵⁹ Other comparable projects during the 60s would be the tradition of wide screen and stereoscopic film like Cinerama (Grau, 2003:157). These entertainment technologies were built for mass audiences and relied on audio-visual stimuli to trigger mental perception of haptic sensations. The major sensory difference was that these technologies never manipulated the users/visitors in the direct and individual manner of Sensorama. Sensorama was an early example of personalized sensory technology.

4.6. OVERVIEW OF KEY RESEARCH INTO TACTILE TECHNOLOGIES

Technologies that enable applications that touch have been steadily introduced throughout the last decades. Has this development been caused by more than technological inventions? What is, for example, the aesthetics of tactility/haptics and what role does it play? My understanding of the ‘aesthetic’ is here referring to the old Greek meaning of the word as ‘sensing, feel, grasp, learn’ i.e. an Aristotelian understanding of it (Seremetakis in Paterson, 2007:84), and placed in the context of media art. The following overview of historical research into tactile technologies will therefore be divided into two parts. In the first part I will look at the more technological approach into tactile stimuli as we see it in the Human Computer Interaction

⁵⁹ <http://www.medienkunstnetz.de/works/sensorama/> accessed on March 2nd 2010.

(HCI) community, the second will treat relevant artistic approaches and projects involving tactile stimulation in the past 20 years.

4.6.1. Tactile research in HCI – Human Computer Interaction

My research is not about HCI, but as there is a certain cross over between my art-specific approach and the design-specific approach of HCI, I will briefly look at research done in this area. HCI is basically about the relationship between humans and computers. The development of the field was originally inspired by the early work of computer pioneers like Wiener (1948), Shannon and Weaver (1948) and Turing (1950) (Gray, 1995:435). The noteworthy Association for Computing Machinery's Special Interest Group on Computer-Human Interaction (ACM SIGCHI) defines HCI as: *'a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.'* (Hewlett ACM SIGCHI Curricula for Human-Computer Interaction). Arguably one could add that HCI is also about constructing the interaction between humans and computers. This wide definition implies that it is a broad and complex subject ranging between different fields such as:⁶⁰

- Computer science, encompassing hardware and application design including Ubiquitous Computing that aims at making all interfaces invisibly built into the users' environment.
- Anthropological and sociological studies of the interplay between technology, work and organization.
- Psychology, which is concerned with the cognitive aspects of the user and the why and how of user behaviour.
- Ergonomics dealing with the usability of computer systems and how interfaces can better facilitate interaction.
- HCI linguistics concerned with the development of human and machine language, how they interrelate, and how they understand each other.

The range of topics included in HCI makes it hard to agree on what HCI really is. Yet this wide variation is also part of the characteristics of HCI. HCI has become an important commercial work field and contributes substantially to various high-end industrial applications within medicine, military and computer gaming industry. HCI is important to the study and development of haptics. It is an important framing mechanism to contextualize developments of haptic history – whereby touch input develops and is allowed to take place. It is however outside the scope to treat the field

⁶⁰ <http://www.webopedia.com/TERM/H/HCI.html> accessed on March 2nd 2010.

of HCI properly in-depth in this research. Another reason for this is my focus on experimental research in Media art where issues of aesthetics are most relevant. The following examples are from acknowledged HCI works in the sector between Media Design (like various MIT research groups) and media art.

4.6.2. Vibratense and tactile languages

Since Braille developed his raised dot alphabet that enabled blind people to read as naturally as the seeing, tactile information transfer has been subject of much research. However, the Braille method is a passive system. It represents a haptic language-based on the active hand sensing passive information in raised dots on paper (Grunwald, 2008:56). A tactile language could also be an active language that writes on to the body, hereby matching the somatosensory system's capacity for sensing vibrotactile stimuli. The artificial tactile language of *Vibratense* was developed by Geldard (Pasquero, 2006:3). *Vibratense* uses the skin's ability for tactile discrimination. It is composed of 45 basic elements – the tactile equivalent of numerals and letters (ibid). Reading speed was reported to be almost three times as high as with expert Morse code. Today it is no longer in use, but represents an interesting finding, indicating both the speed and accuracy possible to achieve with tactile discrimination (ibid). There exist other historical examples of tactile languages. One is the *Quipu* used in the old Inca Empire. This is a language based on strings and knots. Those who knew the language could read it with their eyes closed.⁶¹ Little is known about *Quipu*, but both the physical construction of strings and knots indicate that its reading was corporeal much like Braille as well as dependent upon other tactile references and 'expressions'. Both passive, tactile and active, haptic languages indicate how it is possible to code tactile clues into readable and expressive systems. In turn, this makes it even more likely to construct a haptic language that might function as a medium of its own.

4.6.3. Bach-Y-Rita's vibrotactile display

One early important work on tactile interface technology was Paul Bach-y-Rita's first 'tactile display' built in the 1960s (Bains, 2007). Inspired by the plasticity he saw in his father as the older man recovered from a stroke, Bach-y-Rita wanted to prove that the brain could understand and take on board different types of information. In his first experiment he installed a 20-by-20 array of metal rods in the back of an old dentist chair. The ends of the rods were wired to act as the pixels of a screen. With this tactile display people

⁶¹ <http://en.wikipedia.org/wiki/Quipu> accessed on June 11th 2010.

sitting in the chairs could identify ‘pictures’ poked into their backs. In effect this shows how we can see images with our sense of touch.



Figure 4-11 Portable sensory substitution system developed by Paul Bach-y-Rita and colleagues (1969). © Paul Bach-y-Rita.

Through his research Paul Bach-y-Rita came to the conclusion that ‘*We see with the brain, not the eyes*’ (Bach-y-Rita, 1972). When we see something, the image stops at the retina. From there on it travels to the brain through coded pulses. Being highly plastic, the brain must learn to interpret these signals and form images (Bach-y-Rita, 2003). He continued his research on

the neuroplasticity of the brain and made a 49-point electrotactile array that was put on the tongue. Connecting it to a camera he found that ‘perception with electrical stimulation of the tongue is better than with fingertip electrotactile stimulation’ (Bach-y-Rita, Kaczmarek, Tyler and Garcia-Lara, 1998). This is an interesting neurological finding, but represents a much more intrusive ‘display’ technology than vibrotactile stimulation of the skin. Practically it is hard to use while speaking. Compared to Penfield’s bodymaps (section 3.3.3. and figure 3-2) both the tongue, fingers and the area around the mouth/lips occupy approximately the same space. To use such high sensory capacity areas for conveying specific touches it is to be expected that both type of nerves present and type of effector applied must be taken into consideration. This is a specific, but interesting area for future research.

4.6.4. Tangible computing

Tangible computing is a recent and growing area of research. As the word tangible implies, it is about applications/systems/experiences that are real, material, capable of being touched and/or discernible by the touch. Interesting with the tangible computing area is that it is not about the desktop computer, but about computing in our daily lives with our daily objects (Dourish, 2001:15). As Paul Dourish observes, since it is about our daily experiences it is not just about the physical, but also about the social. Therefore there is a close connection between the research areas of tangible and social computing. In this thesis, however, the tangible research on touch will be at the centre of attention.

The Tangible Media Group at MIT Media Lab focuses on the seamless couplings between physicality and virtuality.⁶² Their main goal is to make the virtual, non-physical bits touchable. To do this they have identified three areas of work: i) interactive surfaces; ii) the coupling of bits with graspable physical objects; and iii) ambient media for background awareness (Ishii and Ullmer, 1997). Working with the fact that interactions with digital information are still largely confined to *Graphical User Interface*, or so called *GUIs*, they have developed the concept of *Tangible User Interfaces*, so called *TUIs*. Similar to GUI’s, TUIs give the user representation and control, but with the addition of physical form.

⁶² Homepage at: <http://tangible.media.mit.edu/> accessed on April 7th 2010.



Figure 4-12 The InTouch roller system for two users. © M.I.T.

An example of this is their *InTouch* project (Brave, 1998) shown at Ars Electronica in 2001. The project is described as exploring:

new forms of interpersonal communication through touch. InTouch uses force-feedback technology to create the illusion that people—separated by distance—are actually interacting with shared physical objects. Each of two identical InTouch devices use three freely rotating rollers. Force-feedback technology synchronizes each individual roller to the corresponding roller on the distant mechanism; when one ‘InTouch’ roller is moved the corresponding roller on the other

InTouch also moves. If the movement of one roller is resisted, the corresponding roller also feels resistance.⁶³

By feeling each other's movements both users can play on telepresently and physically being with the other (Wilson, 2002:619), affecting him/her directly and without time lag. The simplicity of the interface abstracts the feeling of telepresence, creating what they describe as a 'ghostly presence'.

Two of the most interesting aspects of *InTouch* are i) the reduction of telecommunication to a very simple physical level, i.e. felt roller resistance and ii) how it supports the feeling of telepresence. I have myself tried the piece in 2001 and I experienced a definite sense that the way my 'partner' moved the roller was both of human origin and in response to my own rolling of it. Paul Dourish notes that '*although there is no obvious language for formal communication through this system, the developers observed (...) people soon found ways to engage each other*' (Dourish, 2001:178). Simple and open touch devices and functionalities like *InTouch* allow people to develop their own private communication mechanisms. This can be seen as an indicator of a naturally existing, but tacit haptic vocabulary. The use of *InTouch* demands two users. *Social interaction* is therefore also a component of it, or tangible interaction as Hornecker and Buur (2006) call it. They build a framework for tangible interaction around four interrelated themes (ibid):

- *Tangible Manipulation* refers to the material representations with distinct tactile qualities, which are typically physically manipulated in tangible interaction.
- *Spatial Interaction* refers to the fact that tangible interaction is embedded in real space and interaction therefore occurs by movement in space.
- *Embodied Facilitation* highlights how the configuration of material objects and space affects and directs emerging group behavior.
- *Expressive Representation* focuses on the material and digital representations employed by tangible interaction systems, their expressiveness and legibility.

These four points help systematize the thinking around tangible computing, and offers perspectives for future work. Especially relevant for this thesis is their emphasis on embodied facilitation. This contributes to the discussion on psychophysical induction technologies. How to communicate tangibly and socially over distance is described by Antal and Ijsselstein (2006).

⁶³ http://90.146.8.18/en/archives/festival_archive/festival_catalogs/festival_artikel.asp?iProjectID=8232
accessed on November 25th 2009.

Another touch based project developed at MIT is the vibrotactile *ComTouch* communication device.⁶⁴ The basic concept is to connect two handheld devices where each device registers the squeeze under each finger. In addition to voice communication, this squeeze is sent in real time to the other device where it is represented as vibration. The project investigates how to enhance the existing voice communication channel and registered several interesting findings relating to the combination of voice and touch. The mixed modality of audio-tactile communication enable meaningful *tactile gestures*, or representations of touch for expression, like *emphasizing* their speech with tactile expressions to make their message stronger, signaling *turn-taking* for passing the conversation on to the other partner and *mimicry* as a tactile confirmation of presence reminiscent of ‘yes, I am here’ and ‘yes, I am listening’. The project is an example of how a haptic language is allowed to emerge. Further they also wish to inform the development of a touch communication language (Chang, Kanji, O’Modhrain, Jacob and Ishii, 2002).

The area of tangible computing is related to earlier research done in areas known as pervasive, ubiquitous and transparent computing. The achievement of tangible computing is to bring haptic stimuli into the everyday context and living. Its applications are generally fun and playful, but are still lacking enough haptic resolution to create complex contents and expression. Some users have expressed that they find the medium of *InTouch* uninteresting as it lacks the ability to pass concrete information (Brave, Ishii and Dahley, 1998:5). It can be assumed that this is a relevant feedback also for similar devices. However, it is a field with rapid progression and active research communities such as MIT’s Tangible Media Group and the Interactive Institute⁶⁵ in Sweden. The area is relevant for developing answers to the question of what makes up a haptic language and how it can be made.

4.6.5. Force feedback and Phantom

This section will deal with the concept of Force Feedback, its visions and real world applications. Force Feedback relates to the mechanical production of information sensed by the human proprioceptive and kinaesthetic system. Such devices provide primarily kinaesthetic feedback that gives the impression of physical force relative to the visual display (Paterson, 2007:ix). In the real world, virtual surgery is an important field to have a precise and acute sense of force feedback. Several technologies exist on the market. In artistic and creative terms the PHANToM is an interesting tool. The PHANToM (Personal Haptic iNterface Mechanism) device from SensAble Technologies is a force-feedback, 3D device that lets the users sense and

⁶⁴ <http://tangible.media.mit.edu/projects/comtouch/> accessed on June 14th 2010.

⁶⁵ <http://www.tii.se/> accessed on June 14th 2010.

apply touch inside virtual realities and 3D models. The device lets one mould virtual clay similarly to real clay. This is an indication of high tactile fidelity. Its resolution of >450 dpi is one of the highest resolutions available in the commercial mass market for force-feedback. The high end device also have 6DOF (6 degrees of freedom) output capabilities.⁶⁶

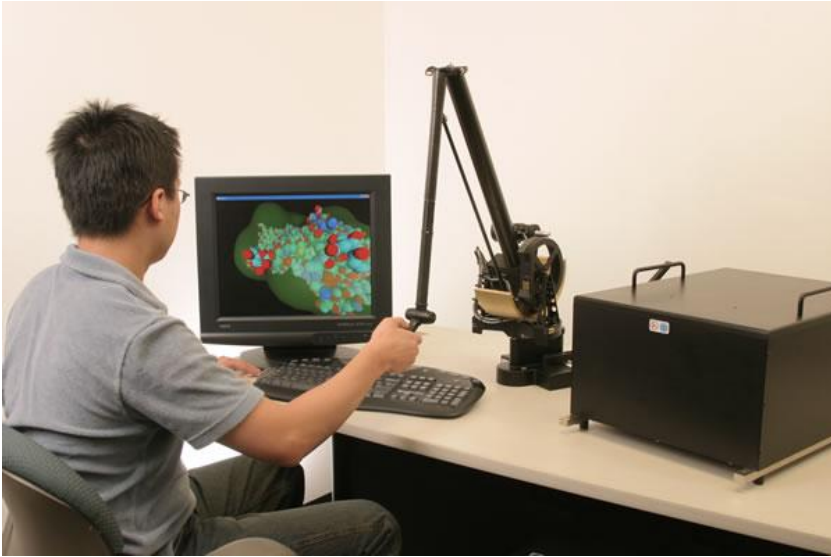


Figure 4-13 PHANTOM device. © sensible Technologies, Inc.

One interesting aspect related to traditional art practice is the way the PHANTOM lets users carve and create models much as in old-fashioned sculpture. Shaped as a one-finger apparatus it does however lack the combined sensory resolution that two real hands and ten fingers can pick out of real-world clay. The results of the phantom are correspondingly simple. However, in combinations with, for example, a 3D scanned model, the retouch with a PHANTOM would bring interesting results.

SensAble technologies market the PHANTOM as having a wide range of commercial applications within areas such as '*ceramics, fine arts & sculpture, games, engraving, relief & flatware, characters & creatures, dental, medical to jewelry*'.⁶⁷ This is characteristic of what appears to be a traditional aim of the PHANTOM device. It primarily tries to reproduce tactile sensations as in the real world and apply real-world force in the virtual

⁶⁶ <http://www.sensible.com/haptic-phantom-omni.htm> accessed on June 14th 2010.

⁶⁷ <http://www.sensible.com/industries-industries.htm> accessed on June 14th 2010.

world. In relation to working with objects this is concerned with recognizing object shapes, textures, stiffness or grasping them and feeling their weight. However, they are openly programmable and used for a variety of purposes including social and tangible computing. In 2002 two PHANToM devices made a long distance ‘handshake’ between MIT (Boston) and UCL (London) (Paterson, 2007:12).

It has also been used as a Collaborative Haptic Assembly Simulator, called CHAS. In this project two designers can collaborate together in real-time. Trials have been done between Labein (Derio, Bizkaia) and Queen’s University Belfast (Northern Ireland). The two remote collaborators could help each other perform the assembly task and feel the collisions with the part grasped by the remote operator.⁶⁸

The origins of the PHANToM and other haptic devices are from long distance remote operation – like the *Argonne Remote Manipulator* (ARM) (Paterson, 2007:130). The CHAS can be seen as a continuation of such technologies.

4.6.6. Haptic cocktail

An interesting application between art and science that uses the possibilities of the SenseAble device is ‘*The Cocktail Party Effect*’ installation by Stephen Barrass and Chris Gunn (Barrass, 2008). It was shown at the ‘Experimenta Vanishing Point’ media arts exhibition in 2005. The installation is a haptic exploration of an invisible cocktail glass using touch and sound in the absence of visual elements. When the visitor is touching parts of the coordinates of a virtual cocktail glass model, then an audio story of the imminent extinction of Great Apes in the wild is heard.⁶⁹ The artist’s statement next to the installation provided the following instructions:

Use the swizzle stick to feel an invisible cocktail glass and overhear conversations at a party. If you to walk away with a mental image of the invisible glass, you will have reached the ‘Vanishing Point’.

Barrass is here using the term *haptic storytelling* to illustrate how touch can trigger the telling of a story. This is an interesting usage of the terminology that will be further discussed in the section on *haptic language* (section 6.6). It is important to note that the goal of the haptic interaction here is to activate the sound that really is the storytelling medium. A quite different approach to haptics would be to tell stories through haptic interaction and vibrotactile sensations.

⁶⁸ http://www.scientificblogging.com/news/what_is_haptics accessed on November 25th 2009.

⁶⁹ <http://www.experimenta.org/vanishingpoint/barrass.htm> accessed on November 25th 2009.

Force feedback represents one of the successful commercial touch-based applications. Its achievement is that you can feel or touch what you see on the screen. The PHANToM device has a high sensory resolution, but is limited as a tangible device due to its short radius and the fact that it is desktop-based. It cannot be used as a mobile medium. An unresolved problem is how to use haptic interaction as a medium on its own, and not having to rely on combination with other media like sound to convey specific content.

4.6.7. Telepresence in the TeleGarden

As mentioned, telepresence is about giving the user some sort of a feeling of ‘being there’ in a remote, separate location. (Wilson, 2002:526). Technologies like telephone, videophone and even email and chat rooms are therefore established tools for achieving telepresence. To a certain extent they give an audio visual impression of the variety and richness of the sensual cues present in the other location. As previously commented, being ‘present’ through *virtual* audio-visual and textual information can hardly compete with the richness of haptic and kinesthetic experience of the *actual* location. The field of contemporary telepresence research often focuses on expanded sensory technologies that let the user physically act in a remote environment. This can be achieved via tele-robotics as in the *TeleGarden* project at the Ars Electronica Center in Austria.⁷⁰

In linking their garden to the World Wide Web and creating an intuitive interface for the control of the arm and camera, the artists transformed what most would consider a fit of over-engineering into a subtle rumination on the nature of the Commons. -Peter Lunenfeld.⁷¹

⁷⁰ <http://goldberg.berkeley.edu/garden/Ars/> accessed on June 3rd 2010.

⁷¹ Flash Art, XXIX, 187, March 1996.

Via a website the users of *TeleGarden* could control a robotic arm and experience control over a garden full of living plants. Users could also plant, water and take care of their plants via the industrial robot of the installation. The maker of *TeleGarden*, Ken Goldberg, commented on the sense of presence: *‘As our reach is extended, we are vulnerable to error, deception and forgery. How do we distinguish reality from illusion? What can we know?’*⁷²



Figure 4-14 The garden of *TeleGarden* at the Ars Electronica Center. © goldberg@berkeley.edu

As a reaction to this uncertainty he proposed the term *telepistemology* as a reference to this subclass of epistemological questions. The question that this thesis expands on is how we sense something as something, and in which ways we can experience haptic telepresence as real? The question goes beyond the garden example. In the garden telepresence is achieved through

⁷² <http://hci.stanford.edu/seminar/abstracts/98-99/990129-goldberg.html> accessed on November 28th 2009.

visual connection between user and an artificial remote body part (robot arm).

The central idea here is not about singular technologies, but about the combination of technologies. According to Daft and Lengel's media richness theory (1986), rich media are those that adding bandwidth, have quick response time, and allow amalgamations of several media (Lievrouw, 2002:224). Also, as discussed by McLuhan (section 4.5), adding more sensory channels can perhaps make communication richer, but not necessarily better. They opposed '*lean*' media to '*rich*' media (as equivalents to McLuhan's 'cold' and 'hot') and suggest that both approaches function best according to situational demands. Sometimes a lean medium is more appropriate to reduce uncertainty. A critical remark against this is that 'richness' is a matter of debate. Currently (2010) the success of Twitter cannot be explained by the richness of content (Twitter allows for a maximum of 128 characters of text), but more likely by its reduction of complexity.

In TeleGarden, users have haptic influence on the remote site, but experience only audio visual feedback via the browser-based interface. If users were enabled to touch and stroke their plants, such touch would most likely enrich TeleGarden. Possibly it would even make the experience more real, but telepistemologically this remains to be tested through haptics (applied touch technologies).

4.7. ARTISTIC PROJECTS ON TOUCH TECHNOLOGIES

The more constructed, the more real.

- Bruno Latour's so called impossible sentence.⁷³

A vision for the integration of computers and telecommunication – the field of *telematics* (Ascott and Shanken, 2003:1) - provides a feeling and touch as in reality. Or, following Rheingold's ideas, if we add rich and imaginative surroundings perhaps we can even improve on reality? This raises an important question for designing touch as experience: is it most 'real' when modelling touches of actual things and people? Or are there other more abstract impressions that can be sensed as real? Perhaps artistic renderings and constructions of touch can appear more real than recreation of everyday, 'natural' touch as experienced without digital technologies. Some projects often have spectacular aims and conceptual frameworks supporting them. Not

⁷³ Ihde, 2003:7

always will or even can they succeed. Nevertheless, as this section will present, there are several artistic projects and developments in the field.

4.7.1. Transatlantic telephonic arm wrestling

In 1986 Norman White and Doug Back set up a simple force-feedback system that allowed participants in two remote locations to arm wrestle.⁷⁴ The technology was based on a motorized custom-built force-feedback system. Through remote modem connection the force exerted on the local electro-mechanical wrestling arm would be transmitted to the remote location, and vice-versa. It was shown in a link between the Canadian Cultural Center, Paris, and the Artculture Resource Centre, Toronto. There from stems also the name 'Transatlantic'.

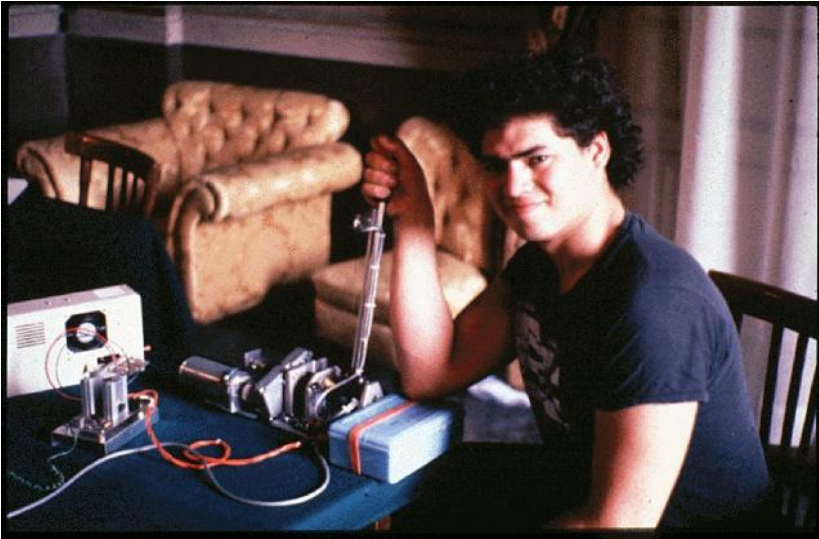


Figure 4-15 One of the two wrestling arms of Transatlantic Telephonic Arm Wrestling. © White / Back.

The project is considered to be a pioneering work in networked communication⁷⁵ and has been recreated with other projects and technologies like the SensAble devices (section 4.6.5). As a system it is interesting for the study of haptics in several ways. Firstly it is a real-time, two way system where the users can exchange brute force immediately, thereby gaining a good sense of presence as well as communication. Secondly, this immediacy makes it to a shared and social event. This demonstrates the importance of having 'real' players at the other end. The opponent could easily be replaced

⁷⁴ <http://www.normill.ca/artpage.html> accessed on November 28th 2009.

⁷⁵ http://en.wikipedia.org/wiki/Norman_White accessed on April 22nd 2010.

by a computer. But then how do you know there really is another guy at the other end of the line? As in the Turing test it is most likely that a machine-like behavior will be revealed over time. One achievement of the project is that it apparently causes a strong sense of telepresence with extremely limited means. Also the distance between the participants makes the project historically interesting. However, its haptic resolution appears limited and the range of meaningful expressions is for that reason uncertain. According to the media richness theory this depends on what message is to be conveyed. In the right psychophysical setting it could prove more significant. Then again, as a stand-alone system it is comparable to the *InTouch* system. It is therefore likely that sensations such as the ‘ghostly presence’ also occur here.

A technology related project is the ‘*Networked Neuro-Baby*’ by Naoko Tosa. This interactive performance system was demonstrated in 1995 between Tokyo and Los Angeles. Users could both communicate to the emotionally expressive visualization of the Neuro Baby software and remotely shake hands by squeezing a ‘Handshaking Device’. This device measured the handshake’s pressure and relayed the position and pressure data to the remote user through a force feedback interface (Tosa et al., 1995; Sommerer and Mignonneau, 2004; Wilson, 2002:794).

Issues of relevance to a user’s experience of these systems are several. What is the haptic resolution compared to a real arm wrestling? Do they reproduce and transmit the exact force each user exerts? What type of feedback and effectors are used? Is it vibrotactile touch, kinetic force or a combination? Is the handshaking device reproducing the touch of five fingers or merely approximating it? These issues would all influence the user’s perception. As the next project shows, sensing haptic information does not always need to have a physical cause.

4.7.2. Telematic Dreaming

The *Telematic Dreaming* (1992) installation by Paul Sermon shows how traditional telepresence based on video manage to provoke a sensation of both touching others as well as being touched by others. The installation connects two separate places via a real-time video-conferencing network. In each place there is a double bed that is filmed from above. The image is then sent to the remote location and projected on the corresponding double bed there.

Person A lying in bed in location A will then see an video image of person B lying in bed in location B – and vice-versa. As Sermon writes: ‘*The telepresent image functions like a mirror that reflects one person within another person’s reflection*’.⁷⁶

⁷⁶ <http://www.hgb-leipzig.de/~sermon/dream/> accessed on March 2nd 2010.



Figure 4-16 Two ‘Telematic Dreaming’ participants lying down, seeing and touching each other. The participant in the remote location is seen as a projection in lower left-hand corner. © Paul Sermon.

Sharing a bed with someone is a powerful symbol, and even if it was only on video, participants often showed reluctance before taking part in this intense and potentially morally ambiguous peepshow (Wilson, 2002). The installation raises several interesting questions of the sexual and political implications of technology. As Stephen Wilson frames it, what ‘*is the meaning of the physical body in a world dominated by virtual representations?*’ (Wilson, 2002:520). Performers of the piece report of a strong sense of physicality as well as the strong connection arising between the body on screen and the complexity of the participant’s material body (Susan Kozel in Classen, 2005:439). This effect appears also in the Videoplace installation by Myron Krueger (section 4.3.1). Even if the installation does not involve haptic technologies, it does induce a strong psychological and haptic sensation of being ‘there’ on the other bed, or having someone in bed with oneself. In so far one could agree on Bricken’s observation on the psychological reality of virtual realities. It appears as if *seeing is believing*. The question is *when feeling is the truth* (Paterson,

2007:37)? In how far is the visual touch of *Telematic Dreaming* real? Although purely visual it is perceived as real by some participants. Somatosensorially it stimulates the users through making them move kinaesthetically. They sense no tactile impressions, but they touch an image as they probably would have touched a real person if he or she was lying there, thereby evoking recollections of touch. This demonstrates Bricken's statement that *psychology is the physics of virtual reality*. The installation's positioning of user in *vision-touch* relationship (Grunwald, 2008:260) to the video is a strong example of what the right psychophysical design can contribute to the sense of touch. As mentioned in relation to phantom limb sensations (section 3.3.1), the *vision-touch* synaesthesia induces tactile sensations via the visual sense (ibid).

A more recent and similar *vision-touch* project is 'Mutsugoto', '*a body-drawing communicator for distant partners*' by Tomoko Hayashi, Stefan Agamanolis and Matthew Karau.⁷⁷ Here there is a more abstract kind of interaction where the participants can draw 'live' on the body of the other. How this abstraction affects the sense of touch is unclear due to lack of user feedback. Anthropomorphically it could be that participants project a wish for human touch into the audio-visual interaction.

4.7.3. Ping Body

... Ever since we evolved as hominids and developed bipedal locomotion, we have always been coupled with technology. We have always been prosthetic bodies. ... But we fear what we have always been and what we have already become – Zombies and Cyborgs. - Stelarc⁷⁸

One of the pioneers in coupling the body with technology is the Australian artist Stelarc. In 1995 he made and performed the *Ping Body*,⁷⁹ a computer-interfaced muscle-stimulation system controlled over the Internet. The performance was broadcast on the net and the audience could remotely access, view and actuate Stelarc's body in his main location. The main setup of *Ping Body* is fairly simple. Network traffic on the internet is monitored and mapped onto the body. The coordinates are marked onto the body by a multiple muscle stimulator directing 0-60 volts to the body. A consequence of this is that all body movements of Stelarc during the performance were involuntary and controlled by internet traffic. At the same time one could say

⁷⁷ <http://www.distancelab.org/projects/mutsugoto/> accessed on November 28th 2009.

⁷⁸ <http://www.stelarc.va.com.au/arx.html> , 2008.

⁷⁹ <http://www.stelarc.va.com.au/pingbody/index.html>

it was both coordinated and choreographed by the external ebb and flow of data. Of the control system Stelarc says:

By random pinging (or measuring the echo times) to Internet domains it is possible to map spatial distance and transmission time to body motion. Ping values from 0-2000 milliseconds (indicative of both distance and density levels of Internet activity) are used to activate a multiple muscle stimulator directing 0-60 volts to the body. Thus ping values that indicate spatial and time parameters of the Internet choreograph and compose the performances.

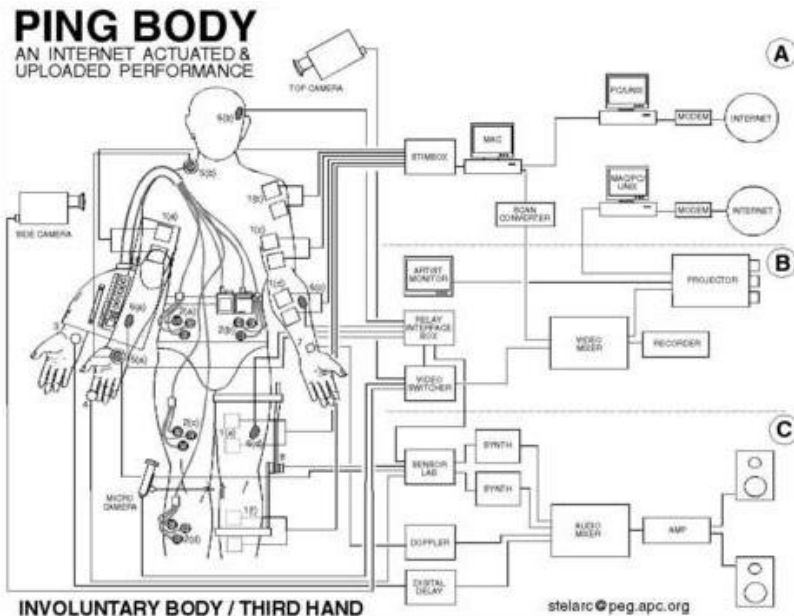


Figure 4-17 The Ping Body technical layout scheme showing how the various technical apparatuses are coupled together. © Stelarc.

The installation is coupled to a graphical interface of the limb motions. The interface both simulates and initiates the physical body's movements. The following mapping of the body relating to proximity, positioning and bending of the arms and legs generates sounds. Letting the body become the product of internet traffic is for Stelarc a '*powerful inversion of the usual interface of the body to the Net*' (Featherstone, 2000:146). The net is a product of the complex interaction of multiple bodies and minds. In *Ping Body* this

collective Internet activity moves the single, individual body. From then on the net is no longer about information transmission, but about the individuals well being. Considering the massive pain and involuntarily convulsion the muscle stimulators gave Stelarc this appears paradoxical.

The body becomes a nexus for Internet activity- its activity a statistical construct of computer networks. - Stelarc⁸⁰

On the other hand one can see Stelarc as the passive victim of the social event. The sensory streaming is one way onto his body. Even though the viewers can watch the painful twitching of his body, they cannot themselves take part. Their own body remains hidden to them.

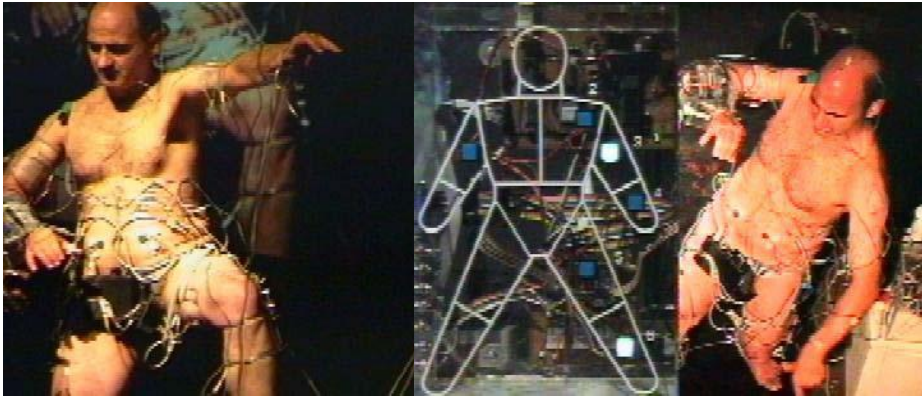


Figure 4-18 The artist Stelarc wired up and in action during a live Ping Body performance. © Stelarc.

Several comments and critique can be given on the *Ping Body* project. Stelarc has succeeded in connecting the body to an online community. The performance is in many ways a social event and connecting people through Stelarc's body. One existential achievement is that the project achieves a high degree of focus on the body as a material. However, it is a haptic one-way communication. There is little or no sense of immersion and telepresence for the user. At the centre of the performance is primarily Stelarc's body and his sensations. Consequently the bodily experience is of isolated nature, and the haptics remains as only visual stimuli to the other participant. The haptic resolution of eight zones is low, but due to the analogue reaction of human muscles to electric stimuli, the body compositions appear more varied and less repetitive than expected. The language expressed is interesting in relation to body arts. In its one-way directedness it appears similar to the *TeleGarden*

⁸⁰ <http://www.stelarc.va.com.au/parasite/paravisions.htm> accessed on April 22nd 2010.

and raises similar telepistemological questions such as if the user (other than Stelarc) really was ‘there’. From point of view of tactile resolution it is comparable to a one-user terminal in my (two user) *cyberSM* project.

4.7.4. Bodymaps: artifacts of touch

The Canadian media artist *Thecla Schiphorst* made the installation ‘*Bodymaps: artifacts of Touch*’ in the period from 1995 – 1997.⁸¹ It is an interactive video and sound installation controlled by a computer. The participant sees an image of a lady projected down onto a bedlike structure covered in white velvet sheet/cloth. The sheet is inviting and sensual to touch. Underneath the bed sheet there are embedded 15 Electromagnetic field sensors and eight force sensitive resistors. In this way the installation can detect touch, pressure and the amount of force applied to the surface. Once the user touches the bed the projected body responds and comes ‘alive’ with sound and movement. Schiphorst tells that the intent of the work is:

to create a relationship between participant and technology that invokes a space of experience, reflection and vulnerability, a delicate balance that attempts to incite an awareness of one’s relationship with oneself through the act of touch.



Figure 4-19 Projection of the sleeping woman onto the ‘bed’ in the BodyMaps installation. © Schiphorst.

Working with the bed as stimulation for proximity and the softness of the surface to encourage caressing, the installation builds an affective space and experience. Thecla attempts to work synaesthetically, connecting various sense modalities, the installation is ‘*grounded in proprioceptive knowledge*,

⁸¹ <http://www.sfu.ca/~tschiphoh/html/academia.html> accessed April 7th 2010.

skin sense feeling, listening through touch, seeing through hearing, together integrated through attention.'

The subversive inspiration of the work is to play on the '*visual/objective relationship between the object and the eye, between click and drag, between analysis and power, to create a relationship between participant and technology that transgresses rules of ownership and objectivity and begs questions of experience, power, and being*'.⁸²

My personal experience of the installation was that Schiphorst succeeded in creating a sensual interface both in inviting the user to touch it as well as creating a strong sense of presence through the responsive projection. However, it is a one way touch interface. The participant is touching the installation, but the touch is not actively returned. In this sense the installation remains a one way experience that critically questions Schiphorst's intention of a synaesthetic sensory experience combining the various sensory modalities.

The installations '*Telematic dreaming*' by Paul Sermon and Thecla Schiphorst's '*Bodymaps*' use touch to let the user interact towards media, but they do not in turn touch the user back in a tactile way. Other projects like the *Reachin Desktop* by Reachin Technologies and the *InTouch* project by The Tangible Media Group at MIT Media Lab⁸³ do this, but these appear more as tools for input than expressive output. They lack an interesting artistic approach and expression.

⁸² http://www.iamas.ac.jp/interaction/i97/artist_Schiphorst.html accessed on March 20th 2010.

⁸³ <http://tangible.media.mit.edu/> accessed on November 28th 2009.

4.7.5. Mobile Feelings

The *Mobile Feelings* project (2002-03) by Christa Sommerer & Laurent Mignonneau (Ars Electronica CODE, 2003:258) is one of the few artistic projects dealing with teletactile stimulation. The project comments on the intrusion of mobile technologies in our everyday life. The massive acceptance of this personal technology has its price. The artists find this phenomenon leaves us with a reduced sense of privacy. They consider how the pervasiveness of such technologies have transformed us all to actors on the stage of everyday living in train stations, restaurants, public spaces, streets, meeting areas, and any other social gathering places.



Figure 4-20 The first design of the Mobile Feelings ‘communicators’ in the shape of small, handheld pumpkins. © Sommerer & Mignonneau.

The concept of *Mobile Feelings* is to explore ‘the ambivalence of sharing personal information with an anonymous audience’. Further it wants to explore the relationship between privacy, ubiquity and connectivity (Stocker, Sommerer and Mignonneau, 2009:205). The artists want the project to create unusual and unsettling sensations of sharing private body sensations with complete strangers over a mobile communication network. Even if they

appear less artistic oriented, the *InTouch* and *ComTouch* projects also work towards creating a haptic interpersonal communication space through touch.

Mobile Feelings focus on the privately haptic by taking away the voice and image-based communication and lets the users communicate via touch and breathing. The technology used is micro-sensors for sensing the users and Bluetooth for communication and transmission of 'touch data' between devices on site. The device registers the user's heart beat through a touch sensor and breath via a breath sensor. The special mobile communication devices are designed as pumpkins in version 1 (image above) and egg-shaped in version two (Sommerer and Mignonneau 2004). Up to six devices can communicate within a ten meter range of each other via Bluetooth, or over the internet via a Bluetooth to internet connection. They are '*pulsating objects to feel heartbeats*' (Huhtamo in Stocker, Sommerer and Mignonneau, 2009:35). The registered heart beats are reproduced in the other eggs as vibrations and the breath of each user reproduced through mini-ventilator blowing air out of the egg.

The *InTouch* project observed that touch is instantly recognized as an indication of the communication being *sincere, immediate and compelling* (Brave, Ishii and Dahley, 1998:4). The haptic effect noticed by Sommerer and Mignonneau is akin to this in that '*both users can thus feel a strong sensation of bodily connection, ... like 'holding each other's heart in their hands'*' (Sommerer and Mignonneau, 2004). They also note that '*the sense of touch still remains one of our most private sensation for which we still lack a concise language to describe*'.

In *Mobile Feelings* the artists have succeeded in reducing a relatively complex interface to an oddly shaped structure with the sensoric and communicational abilities described. Such combinations represent an important contribution to digital aesthetics. A critical issue here is whether the project actually manages to concisely describe the sensation of haptically holding the heart of - and sensing the breath of - another person. The tactile output or resolution of the 'phones' is limited to one output vibrator, which conveys the sensation of a (single) heart beat. The haptic image of a heart is that of a pumping, contracting and expanding organic structure. To haptically record and reproduce this will require several sensors and actuators. This appears beyond the technological resolution of the interface. In the design of the hard outer shell of the interface (version one) vibrations are transplanted equally throughout the whole surface. This makes individual vibratory zones –if intended- hard to distinguish. A rhythmic on/off triggering of the vibrotactile output could possibly induce sensations of contraction and expansion. During my tryout of the devices at Ars Electronica in 2003 I did not have time to study its haptic language beyond what I sensed as regular bursts of vibrations, but these stimuli raised questions of what –besides heart

beats- they were haptically supposed to represent? My immediate response was associative, but not definitive towards accepting the vibrations as heartbeats. User evaluations and observations report that users found the intimate sensation of touch both to be an unusual and unsettling experience. Another critical question here is whether this is a result of the haptic sensations alone or due to the overall project setting and experience. Psychophysically the project is contextually coding users towards sensing heartbeats and breath. Therefore any rhythmic output is also likely to be interpreted as being that. This need not be, but as the project points out above, there is still no concise language to describe touch.

One of the fundamentally important contributions of the project is its use of two way tactile input and output. This marks a difference from many other projects where touch and tactile qualities is usually one way and as output towards the user. Together with projects such as *InTouch* and *ComTouch*, *Mobile Feelings* represents a highly relevant contribution to research on telehaptic communication (Brave, Ishii and Dahley, 1998:4) and is one of the few projects within the field.

4.7.6. The Hug Shirt

A project between the fields of art and design is the *Hug Shirt* by the *CuteCircuit* company (Seymour, 2008:40). The Hug Shirt is as the title implies a shirt that hugs. It is a Bluetooth and java enabled telephone device in the shape of a shirt that lets users exchange physical stimuli over distance. The stimulus is vibrotactile. The shirt works by sensing the user's touch on specific spots. This information is then sent via phone networks to the receiver who carries another Hug Shirt device. The receiver will sense the 'message' as heat and vibrations. When touching the marked areas on the Hug Shirt the mobile phone receives the sensors data via Bluetooth (hug pressure, skin temperature, heartbeat rate, time span of hugging, etc. before it is then delivered to the other person (CuteCircuit⁸⁴).

Interesting to my work on haptic vocabulary is the company's work on developing a taxonomy of hugs. According to the company, they involved users in participatory design sessions to develop the shirts texture and functionality. Exactly how the taxonomy describes the various functions of various hugs remains unclear, but the following is deduced from their webpage:

Hugs come from people that take care of us: mothers, sisters, fathers, grandparents, friends. A hug makes users perceive the tangible presence of the other person. The closeness of a hug

⁸⁴ <http://www.cutecircuit.com/projects/wearables/thehugshirt/> downloaded on September 23rd, 2009.

contributes a sensation of warmth and relaxed harmony. During the hug positive natural chemicals get released within the body, blood pressure is regularized and stress soothed. Rhythmic hugs to let a child fall asleep produce soft vibrations that resonate and calm.



Figure 4-21 The Hug Shirt. Areas with sensors marked with orange circles. © CuteCircuit.

These claims are general, but can serve as hints and indications of how the touch of a hug functions on some levels. Another interesting research done by the company during bodystorming sessions (people hugging for a long time) was the mapping of the position of people hands on the others body. They found major intensity points on upper arms, the upper back part of the torso, around the waistline, neck, shoulders, and hips. The hugging output actuators were placed in these areas, see figure 4-21. They are not placed on the most intense sensory body spots according to Penfield's bodymaps. However, the zones are made to be touched by the high-sensory hands. In relation to Stone's cognitive transpositioning techniques it is likely that the ten spots can be 'reprogrammed' to mean specific sensations with use over time.

Critical issues concerning the Hug Shirt is the apparent limited number of zones (10+) and haptic expressions produced. It appears that the 'hugs' are reproduced through vibrotactile output and possibly heat pads. Without specific descriptions of variability of output strengths, temperature etc, it is hard to evaluate the shirts ability to reproduce a sensation of a real hug.

However, it is my experience that the reproduction of human-to-human and realistic impressions of another human's touch is difficult. The number of perceptions and sensory channels employed in such contexts is simply too high to be reproduced through 10+ vibrating zones. Depending on the context in which the hug is received it might just as well appear as an annoying vibration as a comfortable touch. Similar critical issues concerning the contextual understanding of a perceived touch stimulus are found in the Mobile Feelings project as well as my own projects.

4.7.7. Haptic textiles and the Closer project

Related to the Hug Shirt's integration of technology and clothing is Alison Lewis' *Closer Project* (2004). The project invites its participant to touching behavior through carefully designed fashionable technology (Lewis, 2009). In this touch-based project two participants wear their own electronic garments that react to touch through sensors. There is no haptic or vibrotactile response from or inside the suit. Instead touching the wearers results in either sounds or light effects. The effect is described as 'silly' sounds⁸⁵ and colourful, possibly reducing the threshold for touching others. The project aims at being a playful stimulation of touching behavior.

Wilson sites Maggie Orth: '*Textiles are intimate, and encourage people to touch them*' (ibid, p. 241). Optical clues like the red circles on the Hug Shirt in combination with sensing the different tactile qualities of fabric can haptically guide users towards different types and locations of touch. These factors appear important also for contextual design of vibrotactile stimuli. As Helbig and Ernst note, human perception is inherently multisensory (Grunwald, 2008:235). The Closer Project attempts to combine haptic sense of cloth with haptic touching behaviour. This and other processes of multisensory integration can be affected by learning (ibid p. 244). Provided that the 'silly' feedback is interesting enough, it is to be expected that the textile's projection of properties inviting touch, such as warm or huggable, will influence touching behaviour.

The project appears to receive an overall positive response from users (ibid, p. 243). However, there are several critical questions left open. One is that when performed in smaller environments it is likely that explicit touching behaviour appears socially more acceptable. Since the project consists of only two pullovers with obvious design familiarity it is also likely that participants know they are observed by others. This is likely to influence both behaviour and act as a reinforcer towards a specific acting touch behaviour. These factors should be taken into concern when staged performances are observed and analysed. The project's use of textile texture

⁸⁵ <http://we-make-money-not-art.com/archives/2004/07/wearables-for-a-distant-society.php> accessed on March 21st 2010.

to enhance touch-tactile experience bears similarity to Schiphorst's use of textile on the projection table of *Bodymaps* to create an illusion of warmth and skin contact. Another interesting venture is the *Whisper* project in which wearable body architectures read physiological data and transmit that information through graphics, sounds or haptics.⁸⁶ Also Sabine Seymour's project on fashionable technology (2008) has a great collection of projects and inputs related to haptic textiles.⁸⁷

In relation to touch one can read textiles and cloths functionally from the inside and outwards, but also politically and culturally from the outside and inwards. During the American revolution Americans designed their cloth in homespun and rough material to signify the characteristics of the wearer both in terms of virtue, worth and feeling. The tactile dimension of the cloths became a 'sensory model' for understanding and sensing (Smith, 2008:107). The Closer Project is relevant for the field of haptics insofar as it allows for experimentation with combinations of haptic experience resulting from exposure to different textiles, designs and fashions. Smart garments and textiles are not a main topic of this thesis, but similar and future experiments might provide more insight into how haptic garments influence touching behaviour. One such question is if the perceptual illusions caused by sensory deprivation are due to lack or change of tactile stimulation (section 1.7). The choice of textile quality in my first haptic experiment cyberSM proved integral to the project.

4.8. CYBERSM: A TELETACTILE COMMUNICATION SYSTEM

In 1993, I built one of the world's first haptic, full-body, person-to-person communication system, the so called cyberSM system.⁸⁸ This art project created a multisensory experience based on real time, visual, auditory, and tactile communication in the world of cyberspace. In the first cyberSM experiment, the user began to experience what had been talked about for years: live, tactile communication through a computer environment. The cyberSM project expanded upon text-based virtual environments common at that time: Minitel, MUDs and BBSs. It also took the next step toward multisensory telepresence by combining 3D graphics, live audio, and direct physical stimulation that allowed participants to physically 'touch' each other over distances.⁸⁹

⁸⁶ <http://whisper.iat.sfu.ca/> accessed on April 10th 2010.

⁸⁷ <http://moondial.typepad.com/fashionabletechnology/> accessed on April 10th 2010.

⁸⁸ cyberSM was realized together with Kirk Woolford. This description is based on our official press release on the project.

⁸⁹ A documentation video of cyberSM is found at <http://www.youtube.com/watch?v=pUN6FvObvSY> accessed on June 3rd 2010.



Figure 4-22 The two participants set up of the cyberSM system. On the right three 3D virtual body constructs from the bodybank is seen.

4.8.1. Multisensory communication

The cyberSM project includes touch, sound, voice and visual 3D navigable bodies into its sensory vocabulary, allowing humans interacting in a virtual space to actually feel each other with their bodies. Not only does this physical element of communication let the CyberSM project more closely model inter-human communication than non-haptic communication, it also creates a new form of complex, multisensory interaction. Throughout the cyberSM connection, participants have a physical dialogue, but through the use of 3D avatars they remain anonymous the whole time. This was an interesting span of experience for the users and this virtual carnival of 3D bodies spawned a high interest in meeting the real person on the other side.

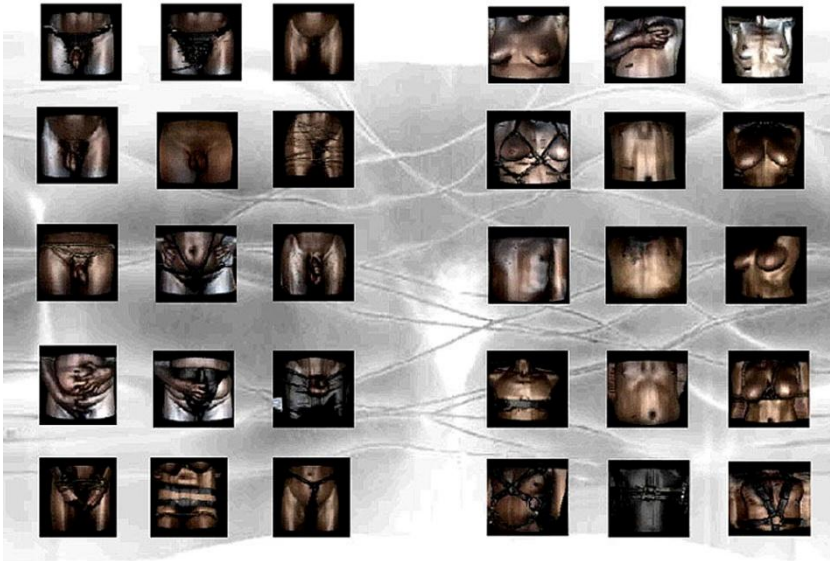


Figure 4-23 BodyBank from cyberSM showing the range of lower (left side) and upper (right side) body parts that could be combined to become the ‘designer’ body of each participant.

The cyberSM project lets the participants choose their own visual identity, or avatar, from a large databank of digitized human bodies. Several users were scanned with a Cyberware 3D scanner. These scans were pre-rendered into QuickTime navigable movies and the resulting 24+ virtual bodies were organized into a ‘bodybank’ – a visual folder of bodies available to the user. The users can here choose their appearance, mix pieces from any gender, rotate the bodies and zoom in or out. Once the body is built, the participant can preview how they will appear to the participant at the remote site. They can test the functionality and configuration of their own suit and, when both sites are ready, connect to the remote site. The local participant’s virtual body is then sent to the remote participant’s computer, where it will be used as the interface for the local participant’s suit. Once connected, the participants can speak to each other over a speaker phone, and control each other’s suits through interactions with the virtual bodies. The participants are presented with each other’s virtual bodies on the monitor or projector before them. By exploring and touching each other’s virtual bodies on screen with a mouse or trackball, they can physically touch one another through the network.

4.8.2. The bodysuit and haptic design

Central to the cyberSM project is the ability to transmit physical stimuli from one participant to the other. This is made possible through the use of stimulator suits which allow the users to remotely stimulate one another's bodies as well as directly stimulate their own bodies. For this I designed custom-made body-suits. Central to such a device is the capability to create various physical stimuli on the body of the wearer. One goal was to design suits that enabled exact positioning of stimuli while the suit could still be worn more or less like as an ordinary suit. This purpose of this was to let the wearer have a certain mobility so that she or he would not find the suit to be in the way of the experience. A design issue then is that the suit would not be too intrusive, be too large in volume or too heavy. As mentioned in section 1.9, one particularly relevant ergonomical question is how to fit bodysuits to our bodies. In terms of functionality, which different haptic stimuli could be applied to which parts of the body, proved to be dependent upon the haptic hardware's function as well as size. An apparent issue is that some haptic stimuli such as the use of pneumatic force and exoskeletons in Burdea's *Rutgers Master I* (1996:126) involve technologies that are too bulky and heavy to be of practical use in a wearable device that should function more or less like ordinary clothing. The challenge of facilitating the placement of haptic technology on the body without getting in the way of haptic functionality is a design issue concerning all haptic bodysuits.

Some of the initial challenges that had to be solved were i) what sensations could be produced by what hardware? Which haptic hardware enabled a haptic speech? With the cyberSM rubber-based suit, would they feel like they were being touched by a human? ii) Considering the bulkiness and weight of both moving machinery and durable battery power, how does one fit everything into a wearable suit? And iii) How does one design a suit that fits everybody? Without a firm and anatomic positioning of the hardware onto the targeted area of the body one could expect less functionality.

Throughout the project these issues evolved alongside together with many other practical issues. In the context of a telepresence installation, what can be perceived as being physical touch? How is it simulated? Or should it even be simulated? Why recreate sensations from 'real reality' if one can feel something brand new and different? The first tests pointed to the possibility of giving touch new meanings. My initial idea was to produce something that resembled being touched by another human. The model of reproducing 'naturalistic' touch became an obvious starting point in developing the first framework of what could be called a *haptic language*. This language is the basis for forming a sensible vocabulary that is necessary in the process of making practical use of the various haptic technologies. In later projects this vocabulary has been developed to model 'standard' to include everyday

sensations like pulling, pushing, resistance, falling, movement from a specified direction, the movement of the wind etc.

For cyberSM I started out with an overall and open approach towards any kind of electromechanical device that would shake, move or vibrate. The first design incorporated various sensory stimulators, including heating pads, various vibrators, low-wattage capacitors for delivering shocks, and automatic injectors filled with various ‘designer drugs’ (optional). These haptic output devices I call *effectors*. Others have called such output devices for ‘tactors’ (see TactaVest in section 4.4.1 and Figure 4-7). To control the effectors I used an electronic and computer controlled output device with eight 5 volt outputs. These outputs could be triggered according to real-time activity. Their functionality was ‘digital’ in that they were either on or off. The strength of the effectors was therefore not possible to adjust and was always the same. My different constructions of haptic hardware as well as expressions will be explained more in depth in chapter six on the Erotogod experiment.



Figure 4-24 Two examples of 3D navigable and ‘touchable’ cyberbodies.

Having developed various functional light-weight effectors, the next challenge was to build a system that would enable precise fitting onto the participant’s bodies. The initial idea was to build a suit. But how does one make it fit both tall and short, male and female, thin and fat? For cyberSM this was solved by constructing a system of belts that fitted different body parts. The main belt was positioned around the waist as a strap-on-trouser with all input cables meeting at the naval point. Two circular vibrator tubes were placed between the legs and around the torso and connected to the main belt. Additionally belts were made for both of the arms and legs. The final

belt was made for the breast. All in all the bodysuit was so made up by seven belts and one 'trouser'. This system was both flexible and adaptable and fitted most bodies. Throughout the projects life span (1993 – 95) and in the course of dressing several hundreds of uses, this proved to be a good ergonomic decision since bodies come in all sizes. An incident on the upper scale was with a Russian journalist who was so huge that several pieces ripped apart. On the smallest females the suit had to be tightened with extra belts and textile tape.

Designing bodysuits is closely linked with the design of the haptic stimuli applied. The next section will look at the stimuli applied in the cyberSM suit.

4.8.3. Effector placement and stimuli

The tactile stimulators of the first Bodysuit were designed to be placed over erogenous zones, including the breasts, the anus and the genitals. The suit also has two flexible body vibrators designed to stimulate the inner thighs, as well as portions of the torso. Two other stimulators are the self-made shock pad and the touch pad. Both are constructed to be attached to the legs. The touch pad releases a stream of heat, similar to the touch of a warm hand. The shock pad delivers electric shocks of various strengths and frequencies. The latter two devices can be freely strapped to any part of the body where the participant wants the stimulation to be applied. The suits also came with other vibro-stimulators with different design and functions, and that could be attached to areas of the body according to the user's individual wish. The bodysuit is controlled by both participants. The kind and amount of stimuli being sent and received are controlled in part by the sending participant and in part by the configuration of the person wearing it. Each user could at any time disconnect, disengage or re-channel the various belts and effectors. Most participants never did so, but some reacted more strongly to the electric shock. Even if it was experienced as painful few actually took it off.

The placement of the vibro-stimulators to erogenous zones is to maximize the effect of the tactile stimulations by the suit. The suit is limited in the number of ways it can simulate physical human-to-human contact, but direct stimulation of intimate zones on the body, coupled with voice feed-back and visuals, gives a direct and therefore realistic impression of being touched personally by someone. Even if the actual haptic output onto the body is fairly abstract it soon became obvious that it is given meaning from the contextual references in which it is felt. The haptic stimulation alone quickly became monotonous, but the multisensory combination of touch through the bodysuit combined with the visual 3D body on screen and the voice connection mutually strengthened each other. Combined it expanded on the sensory bandwidth of the communication and induced a fairly good sense of 'being there' with the other partner at the other end of the line. No data were formally recorded during the cyberSM performances. My assessment is based on the oral feedback given during conversation with participants of numerous performances and shows all over Europe.

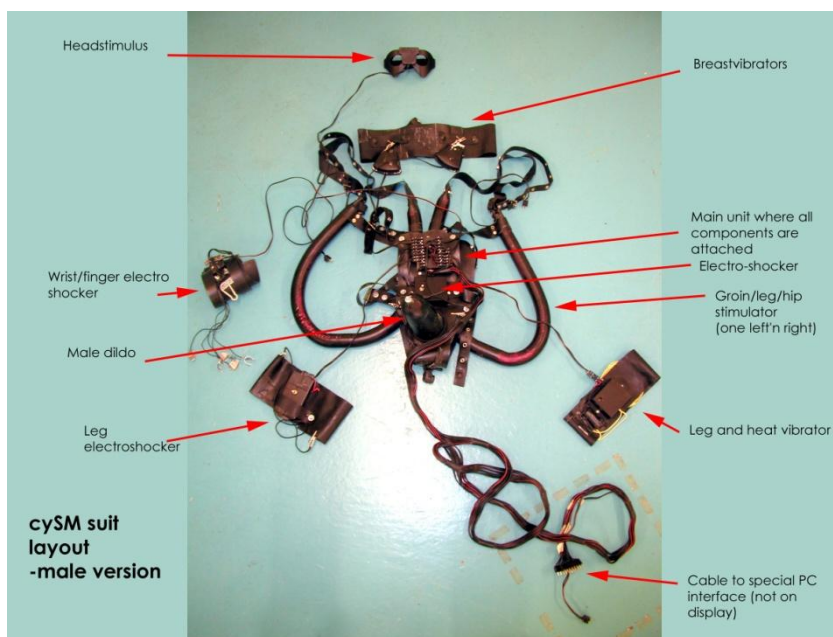


Figure 4-25 Layout of the cyberSM bodysuit showing various belts attached to the main belt/unit. The male and female version are almost identical with the exception of the dildonic unit.

How does the effector placement and stimuli compare to other projects? Pre-1993 haptic interfaces like *Sensorama* and *Transatlantic Telephonic Arm Wrestling* utilize external devices to produce haptic stimulation. In cyberSM a wearable, partly mobile and anatomically adaptable suit was constructed for the first time. As discussed in section 3.3.4, haptic sensations are influenced by the psychophysical context. The next section will look at some of these moments that became influential on the perceptions of its participants.

4.8.4. Contextual coding

In cyberSM all users dress not only in a bodysuit, but also in sensations. This is not due to the bodysuit's haptic functionality alone. Users are in general very aware of their context, reacting to numerous design issues in their environment. Their expectations as well as behaviour are being influenced from the moment they see an interface or an installation. In cyberSM all elements were carefully contextualized in a consistent kind of aesthetic appearance similar to Sado Masochistic fashion and practice, hence the SM in *cyberSM*. Looking at the installation's set up accordingly gave the impression as if some intensive corporeal experience associated with S&M practice could happen. Once the users were dressed and online the suit also proved highly 'corporeal' in its functionality. The overall system design attracted users and its visual appeal psychologically prepared them for the stepping out of ordinary modes of communication. The more or less spectacular appearance of the bodysuits made international headlines and the project was shown in a broad range of important international media between 1994 and 1995.

Such design of user's cognitive perception points towards the overall importance of a holistic approach to the design of VR worlds, from the VR world itself to the ergonomics of the interfaces, to the physical appearance of the system. In its novelty and mechanical crudeness, the multisensory communication system of the cyberSM project was considered by a French journalist to be technologically comparable to the first steam-engine. It functioned, but had a limited range of expressions. I got intrigued by how my own perceptual experience was affected, influenced and shifted within the framework of telepresence. These effects, however vague when present, were also indicated by others and my observation. Telecommunicating physically and corporeally with others affected the way they acted, most notably in high activity levels and social engagement. Participants also expressed strong feelings of environmental immersion in the telepresent context. Several users gave the impression they were touched for real by the other person.

To focus on touch as a medium on its own I developed the *Inter_Skin* project shown at ISEA in Helsinki in 1994.⁹⁰ Here the visual communication surface is taken away and ‘replaced’ through the development of an ‘intelligent’ two-way touch suit the body becomes the interface for communication between the participants. Both participants wear a sensoric outfit that is capable of both transmitting and receiving different vibrotactile stimuli. Rather than communication through a monitor as *interface*, the body becomes an *interskin* to convey, exchange and receive information. The main emphasis of the communication is in the transmission and receiving of touch. By touching my own body I transmit the same touch to my recipient. The result is an affective user experience (Tikka, 2003). The three main points of *Inter_Skin* is the technological development of ‘sensitive’ clothing that can be experienced as a ‘second skin’, the practical inclusion of the body as the surface of interaction and the haptic design of a new and ‘transparent’ bodysuit. This work on affective experiences and interfaces became intensified in the next project *Solve et Coagula* (1997).

4.9. SOLVE ET COAGULA (SEC) – MATING MAN AND MACHINE

After the first haptic experiments of cyberSM and *Inter_Skin*, the overall focus of my installations have changed to better understand the nature and indeed technology of multisensory experiences. I have focused more on developing technologically advanced multisensory system designs for single users, that is human-to-computer-interfaces. This has enabled me to focus better on individual perception. Going from a two-user Human-Computer-Human system to a one-user Human-Computer-Interface simplified a few matters and complicated others. Humans tend to produce content immanently through social transaction. From the perspective of usability, interacting with only a computer demands an interesting and engaging immersive virtual environment. From an artistic point of view this is a challenging design issue, but this approach let me focus more on both increased sensory resolution as well as studying the effect of haptic interfaces on the user experience.

After the construction of the first cyberSM bodysuit, the sensory output resolution of the next level bodysuit doubled from 8 to 16 zones during the *sense:less* project shown at the Electra exhibition at Henie Onstad Art Centre in 1996. It was not until the *Solve et Coagula* project⁹¹ that I was able to develop an interface with a sensory resolution covering the whole body. Developed partly at the C3 centre in Budapest and shown at Ars Electronica in 1997, the *Solve et Coagula* installation was an art-technological attempt to

⁹⁰ Built in cooperation with Kirk Woolford.

⁹¹ For the project description see www.stenslie.net. The project was conceived together with Knut Mork and realized in cooperation with Lars Nilsson and Karl Anders Øygard.

give birth to a new life form: half digital, half organic. It was an initial experimentation with what could be labeled a symbiotic system with an interdependent sensory loop between man and machine. The project describes a 'transhuman cyberorganism'. The experience thereof is dependent upon a machine body and emotions that simulate a trans-species encounter. The project subtitle says 'mating man and machine'. This is accurate in as far as the project attempted to sensorially pair man and computer together. The cognitive and corporeal experience mixes and materializes in the shape of the new machine-body of the cyberorganism.



Figure 4-26 Views from the installation. In the middle the user surrounded by the 'creature' which the body suit rendered haptic.

The artistic goal was to question what happens when the machine turns human, and the human turns machinelike. The user and machine is joined through a bio-cybernetic interface consisting of a sensoric stimulation-suit in combination with visual and aural immersion. The machine is essentially an 'intelligent' software that is programmed to 'feed' on the user's input. Examples of input that influence the machine are indirectly expressed emotions like fear and lust, and controlled bodily expressions like speech, shouting and movements. Through bodily stimuli, 3D sounds and an

immersive VR world, the machine attempts to manipulate the user into behaving in affective physical expressions. If the computer-based intelligence is in a state of 'anger' it would encourage 'angry' movement and vocal expressions from the user. If it is lustful it responds to 'lustful' input. For this causal interaction loop we designed and tested several models and parameters for emotional input and output. The machine is 'fed' through the sensors placed inside the bodysuit, and the user can influence the computer-creature to adjust the intensity and dramaturgy of the installation. The art-experience has become a sensual fusion of man and machine, pushed forward by a symbiotic interactivity, a form of interaction that is dependent upon the user's presence and bodily functions.

4.9.1. SeC installation

On entering the installation the participant steps inside a five metre tall ovoid shell of metal arms. This is another example of the contextual and psychophysical coding of the installation. In SeC one of the goals was to construct an encompassing physical installation that corporeally impresses the user in a completely immersive manner.



Figure 4-27 The five metre tall installation of iron at Kunstneres Hus in Oslo.

Building on the experience from cyberSM, a successful perceptual experience is a matter of several senses playing together, including details down to the visual design of the equipment. Also here the psychophysical coding by design of the physical environment was important to guide the user's perceptual experiences. Video beamers projected a view of the creature's constantly changing body on projection surfaces placed around the

installation. The visual manifestations change constantly in response to the participant's movements and vocal output.⁹²

4.9.2. SeC bodysuit and tactile resolution

The body suit worn by the participant serves as an intelligent, two way communication interface to the creature. It provides (i) tactile stimuli so that the creature can touch the participant's body and manipulate his haptic perception, and (ii) built-in pressure sensors through which the creature can sense the user's body.



Figure 4-28 The SeC bodysuit. The up to 120 effectors are equally distributed throughout the suit, effectively covering the whole body. The user holds the pressure sensitive devices in each hand.

Whereas the bodysuit of cyberSM covered the main regions of the body, its effectors were sensually speaking only covering eight zones on the body. I use the term 'areal-effectiveness' to indicate how much of the total area of skin/body it stimulated. The overall areal-effectiveness of cyberSM was approximately a third of the body, and therefore comparatively low. The SeC project developed the first bodysuit to practically completely cover the body.⁹³ Inside the SeC bodysuit the participant is equipped head-to-toe in the

⁹² The documentation video of the project is found at <http://www.youtube.com/watch?v=SkFOZ5Gy4bQ> accessed on March 22nd 2010.

⁹³ Designed together with fashion designer Siv Thorud.

tools needed for interacting with the artificial intelligence: the lightweight body suit, microphone, and a head-mounted display.

Tactile resolution can be defined as how much of the body is being stimulated at what intensity and by what stimuli. The SeC suit had a vibrotactile resolution of 120 zones each haptically influencing an area of the body of approximately five by five centimeters. A zone was comprised by a self-made vibrotactile vibrator where a micromotor served as the main effector. Through our custom built interface each effector was individually controllable and variable in strength from the slightest shivering to intense vibration. The zones were designed to be fairly equally distributed across the body apart from the feet. This exception had more a practical reason of risk for cable strain and breakage. Besides this the feet are indeed an interesting area of the body to include. In their hands the user held two organ-shaped pressure pads with built in, custom-made pressure sensors and effectors.

One main difference introduced with the SeC' suit compared to other bodysuits and haptic devices is the increase in vibrotactile resolution to cover the whole body. This enabled more complex haptic expressions.

4.9.3. The beginning of a haptic language

The genesis of a haptic language is long and at least dating back to Giovan Battista della Porta (1535 – 1615), the previously mentioned inventor of the camera obscura (section 4.1). He proposed a cryptographic and telegraphic system built upon a direct stimulation of the flesh (Zielinski, 2002:98). Two 'friends' were each to have an open and fresh wound. Around the wound there should be two circles containing the alphabet. Communication should happen by 'typing' letters with a knife on the one 'friend'. The other 'friend' would then 'sympathically' feel the corresponding letters and vice versa. Messages could so be exchanged (ibid). It is hard to foresee a practical way of constructing such a 'bodygraph', but it is conceptually relevant for the use of the body to both write and decipher message, and hence to the development of a haptic language.

To my observation, many users showed common reactions to certain haptic expressions in cyberSM, Inter_Skin and SeC, thus indicating the existence of a haptic language that is corporeally comprehensible by all humans. To complete its description is out of scope here. The intention is simply to start with the listing of contributions to a future vocabulary of touch. A haptic vocabulary is a supply of expressive techniques or devices, possibly a list or collection of terms or codes of touch available for assemblage into meaningful haptic expressions. The resulting combinations should literally make sense.

With the increase in sensory resolution the SeC suit, one could for the first time talk about having the possibility of developing a haptic language.

The resolution enabled the construction of complex sensory patterns to be imprinted on the body. To better design these haptic patterns the 120 effectors were mapped out onto a 3D drawing of the body. (Figure 4-29 and 6-16) On this image the various touch patterns were drawn so that we could more easily envision their effect and code them into the computer for testing. The patterns were designed both in sequence of zones triggered and the individually variable strength of the effectors. The design of the patterns varied from string-like, linear triggering of the effectors to larger areas being triggered simultaneously. The first SeC version used around thirty different patterns in various combinations.

The haptic perception induced by the patterns varied. Our haptic vocabulary developed into being able to create distinct sensations from being pulled, pushed, resistance, weight, (human) touch, tickling to objects and 'insects' crawling around on the users body. One user in the initial blind test was not told anything about what the sensations could or should mimic, but had several scary impressions and reported during one instance that insects were crawling on the body.

We also tried to induce sensations of things going inside as well as through the body. Most users had an impression of the suit being alive. To maximize the physical effect of each effector it was important to get it placed as close and firmly onto the skin as possible. The suit was designed with light weight, stretchable cloth that was easy to strap onto the different body parts. More effect was achieved when users were naked beneath the suit, but due to the number of participants and for hygienic reasons we let them wear light clothing underneath. The strength of the effectors was clearly felt even then. The custom-built interface has a maximum electric output of ten amps power. When most of them were triggered the users were given a strong sensation of the effect of one watt of electrical power.

Inside the installation these patterns were triggered by the emotional states of the computer according to our dramaturgical evaluation of their effect. For the first time having experience with the whole body as a sensual canvas, it became a matter of open experimentation of finding out what sensation each pattern would trigger in what state of the installation. As we found out this also varies from user to user, but there are definitely patterns that most users recognize. Additionally to the predesigned patterns the installation would also trigger individual zones-based upon the character's state of mind.

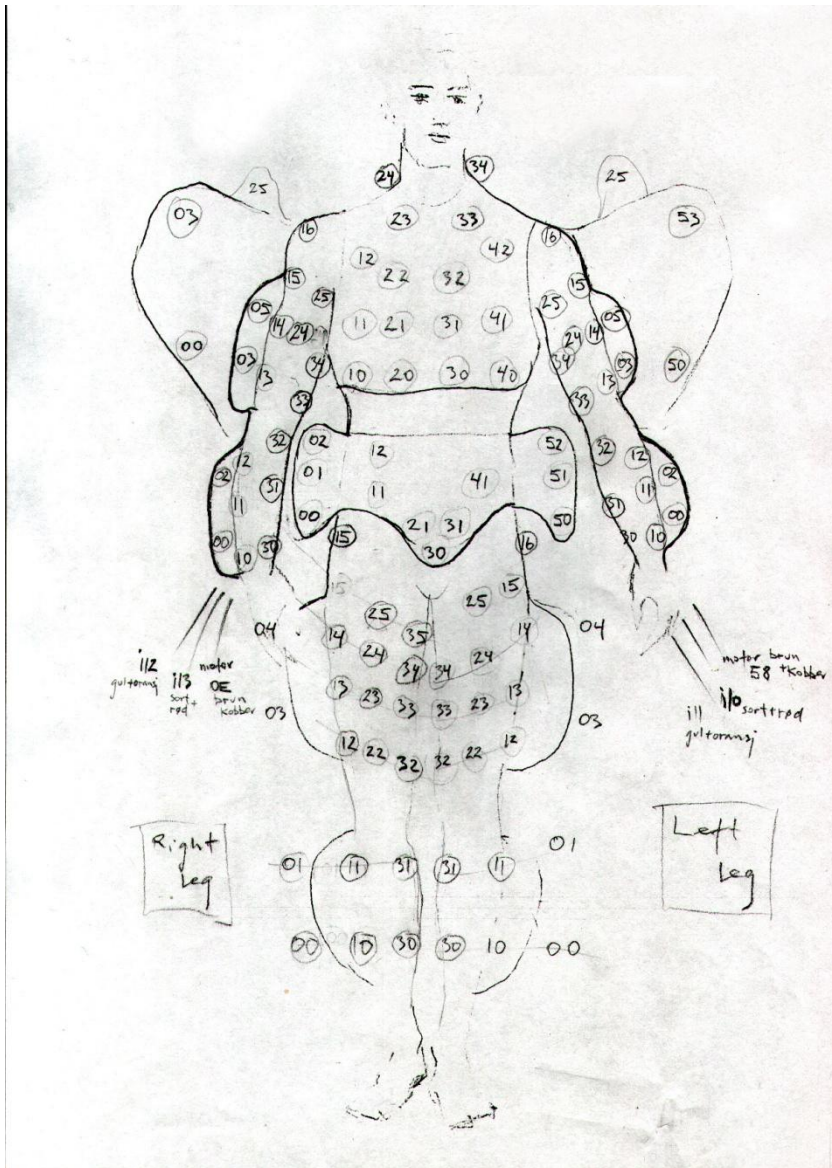


Figure 4-29 Illustration showing the effector placement in the SeC bodysuit.

The suit was designed in one piece that was easy and fast to dress. It was built like a human skin to be wrapped around the body. Altogether it weighed around two kilos including cables and was both fairly comfortable and transparent to use. What however had a noticeable weight were the control cables that attached to the suit as an umbilical cord. For the 120 zones we used 240 cables, two for each vibrator. Their weight impairs the user slightly,

but by attaching them on the back and hanging the cables from above this was not a too noticeable a problem.

4.9.4. Physical 3D sound environment

The computer-based creature speaks to the participant through moving, three-dimensional sounds projected from the eight channel sound system surrounding the installation. Its ‘voice’ is a bizarre, mutant-like combination of organic noises and distorted samples of the human voice. The sound, and in particular in combination with a subwoofer, also has a physical effect on the user. Normally sound is discounted as corporeal stimuli beyond listening to music. As the extremely loud music performances by the Austrian art group Granular Synthesis shows, it can indeed be used to create strong corporeal sensations.⁹⁴ The implementation of 3D music in SeC was first meant to create audible aural movements in the space of the installation. This was thought to help the user as points of reference for their navigation. In practice it is hard to map a physical installation, 3D visuals and sound precisely together. One of the problems here is the need for a larger, reflection-free space to ensure a higher degree of control over sound positioning. However, even if the sound was less of a navigational helper, it did have a corporeal effect on the body. Having a powerful speaker and subwoofer at hand, the sound of the installation proved to fill the space with a certain sense of physical density. It affected the body with an additional corporeal sensation. The most extreme use of physical sound I experienced a few years later when passing by a disco for deaf people. As The National Aural group states: ‘*Disco music or Bach, opera or pop, Shakespeare or rep – all can be heard and enjoyed by deaf children*’ (Denmark, 1994:16). You certainly don’t need to hear the music to dance when its amplified waves physically impact your body with rhythms. The same principle of ‘hearing’ sound through the physical affect of sound waves was inspirational for the aural design of SeC.

4.9.5. Vocal and corporeal input

The installation gets its input from the user through voice and body. Just as the creature expresses itself vocally to the participant, so does it in turn respond to the sound of the participant’s voice. It attempts to analyze the pitch and tone of their utterances as some kind of emotional feedback, and respond to the participant in ways it deems appropriate. Through two organ-like shaped figures held in the hands, the participants could touch the creature by pressure sensors. (See figure 4-28).

⁹⁴ <http://www.granularsynthesis.info/> accessed on November 29th 2009.

4.9.6. Sensory reset

The perceived strangeness of the situation being placed inside an alien setting has the effect of resetting the user's expectations. Without familiar clues from familiar environments such as the computer screen, mouse and keyboard, the user does not anymore know what to expect. This leaves him or her open to what can happen next. New impressions can happen. Such a technique of 'sensory reset' is a known applied method within commercial exhibition design. Catching the attention of visitors is essential in these contexts. A similar notion to the 'sensory reset' is also found in Merleau-Ponty's understanding of habitual perception. Our body is comprised of two layers, the *habit-body* and the *body at this moment* (Merleau-Ponty, 1962:71). To the *habit-body* the world is obvious, transparent and manipulative. To the *body at this moment* the natural connection has broken down and it has become externalized as 'a thing manipulatable in itself' (ibid).

Marketing tricks of 'shocking' the perception into reset are risky. What if the participant does not get their expectations satisfied? What if the product is not what is promised? Such attention grabbing design can be overdone, and some users approached the installation with a perhaps bigger expectation than the multisensory interface could give. Every user was met by a personal guide that both instructed at the start of the installation and asked the user about his experience at the end. Although we did not record user's responses most of them verbally gave a very positive feedback of the overall experience. Psychophysically the design of the environment appeared to have a positive influence on the users. As discussed in section 3.3, psychophysical manipulation is a technique to both tune user's perceptions and manipulate them towards sensibility for specific aesthetic expressions. The visual and audible dimensions are important factors here.

4.9.7. Visual and aural immersion enhance tactility

The participant wears stereoscopic viewing glasses⁹⁵ through which they are visually immersed inside the computer-constructed 3D reality of the creature's body. The creature presents the participant with organic 'body parts' as representatives of its various emotional states. The creature brings the participant to each body part through a vein- or intestine-like labyrinth of tunnels. It has five different organons, each representing a different state of mind of the creature. The visuals as well as the sound became important to contextualize how the users experience being touched. The touch patterns appeared to be better understood when synchronized with the visuals. One reason for this is the unusual stimuli of being touched 'intelligently' by something as mechanical as a bodysuit. As McLuhan writes on hot and cold

⁹⁵ I-glasses with VGA resolution (640 by 480 pixels).

media, users seem to be looking for sense and meaning. Cold, low bandwidth media can therefore at times be more interesting and emotionally immersive than hot, high bandwidth media.

To make sense out the touch one needs a certain haptic resolution. In difference to the cyberSM suit where the touch alone was too mechanical and abstract a stimulus, the SeC users could make content out of the bodysuit as a standalone application. However, the combination of sound, visuals and touch provided the necessary multisensory bandwidth to expand the value of the experience.

Without the bodysuit the installation also appeared as an interesting sculpture, attracting response from visitors. The visuals and the sound enhanced the aspect of public spectacle and attracted attention, but for the user inside moving around and being touched it intensified the immersive effect. From an artistic perspective it was the multisensory challenge that set the installation apart and let it present something quite different from other, more traditional art installations.

4.9.8. Usability issues of SeC

Even if unusual and ‘alien’ in appearance, the installation was designed to be easy to understand and use. All feedback from users pointed to this. Each user was dressed by an assistant that briefly explained how the system functioned. User responses varied from those dancing around to passive behaviour where some users just stood still waiting for things to happen. In most cases the users of the installation would move and look around, but it was generally harder to make them use their voice. Vocal input seems to have a higher social threshold before people are willing to use it. The multimodal interactivity system of SeC attempted to manipulate the senses into a sensory symbiotic relationship between user and computer system. It thereby confronts the user with unknown, strange and irritating phenomena. This fusion of technology and art attempted to transform the artistic experience into an aesthetic process of interaction.

One of the foundations for the project group’s work on developing a transparent and intuitive interface was the access to the best hardware of the 1990s. The installation used a high-end graphics computer at the time, the SGI Onyx (1997). This hardware made it possible to render realtime graphics in high resolution outside of renderfarms and specialized labs. The bodysuit was controlled by proprietary interface technology built especially for the project. All software (OpenGL, C) was written by the project group.

4.10. SUMMARY AND DISCUSSION

This chapter has examined some of the more significant historical developments that have inspired and enabled haptic works of art. It has

presented a partial overview of the media-art field framed from a haptic point of view. Starting out with historical research into visual representation techniques and ideas that led to telepresence and immersive systems, the chapter proceeded towards projects dealing with touch and touching technologies. In this way it frames the field of digital media art that this research is situated within. It describes and discusses my earlier projects *cyberSM* and *Solve et Coagula*. So it portrays both chronological and historical processes that eventually led to the development of the *Erotogod* experiment. The chapter goes into the design of the first bodysuits, which was the interface that inspired me to pursue my current research and results with haptic technologies. Through my observation of users in my initial bodysuits I discovered what is described in chapter one as ‘wicked problems’. This appeared in my works through a timely combination of art and technology as well as putting the interface right onto the skin. The result led to my initial discovery of the possibilities and advantages of haptic stimulation.

This partial overview of the field has shown that the questions and problems of using touch as a medium has a short history. The projects mentioned indicate that applying the medium of touch enriches user experiences. Many of the issues that my work with touch in multisensory environments poses have not been previously answered. My artistic explorations open up a new field relevant both to research in new media in general and works on multimodal art installations in particular.

The partly practical, tacit as well as explicit knowledge gathered in my initial experiments led me to theoretical reflections on how we are embodied in technologically-supported realities. The development of this reflection towards a phenomenological position will be discussed in the next chapter.

5. THEORY - ON EMBODIED EXPERIENCE

How do we experience touch? To answer this question this thesis will also ask what experience is about. One thing we know is that what we sense is of fundamental importance to us:

The most lively thought is still inferior to the dullest sensation.
- David Hume.⁹⁶

Hume's statement indicates how the world of our body captivates us completely. From a physiological point of view we are constantly immersed in an ocean of physical impressions. One question to be addressed therefore is how we consciously process these impressions and –in turn– how we use them to form and give meaning to the world.

The following chapter concentrates on the embodied experience of touch, posing questions related to theories of experience. These are questions such as: What do we mean by saying we corporeally experience something? What is it that we really experience i) with objects and ii) in interactive media art? What is it that we really experience when interacting with objects? And what makes everyday sensory experiences different from experiencing interactive art installations?

It will treat different theoretical approaches to touch from Descartes to Phenomenology. Initially the chapter will briefly introduce some important theories of perception. Further, it will analyze the breakdown of the '*natural attitude*' that happens in the meeting with human computer interfaces and more generally with technology. This leads to discussion of Heidegger and his Present-at-hand and Ready-at-hand concepts. Focusing on the importance of physical experience, an argument for embodied consciousness is advanced, based upon Merleau-Ponty's understanding of the *natural attitude*: the way we behave in the world as if it is not problematic (Merleau-Ponty, 1964:163).

⁹⁶ In Copleston, 1964.

One centre of attention will be on phenomenology as Husserl saw it: as the eidetic⁹⁷ science of experience (Moran, 2000:132 and 2000:134). Husserl was concerned with finding the ‘essences’ or ideal meanings of the acts of our consciousness (Spurling, 1977:8). This is the so called eidetic or phenomenological reduction. Merleau-Ponty expands this view through investigating our ‘natural attitude’. The experienced driver does not have to think or reflect too much to drive a car. With experience driving becomes a natural attitude. That is a flow of experiences which imply and explain each other both simultaneously and successively. In fact, most things we do in our everyday lives go unnoticed. To bring them to view, Merleau-Ponty suggests we ‘*suspend for a moment our recognition of them*’ (Spurling, 1977:8). This is the ‘phenomenological’ attitude, and as Heidegger shows, reflection may start in the moment when a tool at hand (like a hammer) breaks (Heidegger, 1978:105). This example impinges on the discussion of interface and ergonomics. Bodysuits, for example, are not natural, but once we are used to them, they become a second, natural skin. Reflection is triggered when this second skin impose users with perceptual break down. That could, for example, occur through a sensation that is perceived as unnatural.

The chapter starts with an investigation into experience leading to the discussion of how touch affects us through discussing how our bodies, histories and environments *afford* us, that is how they determine ‘*what shows up in the world*’ (Watkin, 2009:21). The word afford is here used in the sense of facilitating for certain experiences, see section 5.8.

5.1.1. ON THEORY AND ARTISTIC PRACTICE

My own artistic practice has been focused on creating strong physical experiences. This is also the starting point for my interest in interactive arts: how multimodal interface technologies open up new ways of modelling physical and corporeal experience. My contributions to the field have been various, but perhaps most notably in the design of haptic body suits as new ergonomic interfaces that enhance multisensory experience.

In line with the focus on touch, the body is here put at the centre. Here it is about the corpo-reality of the experience of touch. The haptic interfaces I employ deal with the skin as the immediate interface for embodied experiences. I am aware of the ontic/material and equipmental character of my installations in the sense that the material substance is in itself one of the founding conditions of perception. This becomes evident every time when the smallest cable breaks down, not to mention when a computer needs to be reset.

⁹⁷ Here eidetic is used as in ‘seeing essence’.

The following approach to embodied experience represents the view of an art practitioner and is based on reflections on my own work. Working within the field of media arts since 1991, I have experienced various media art projects that involve embodied experience. I have done so both through the variety of installations I have built as well as an observer of user behaviour inside my own and others' interactive installations.

The four research questions raised in chapter one concerning perceptual symbiosis, sensory resolution, the real virtual sensation and the possibility of haptic expressions will here be approached through the investigation of touch by way of phenomenology. Attached to these are more general investigations related to question such as: How can we study our experience of the world and how can we gain knowledge from it? How is perception built, modelled or even manipulated by our physical environment? How does the interactive dimension influence our perception? How can we develop an understanding of cross-modal combinations involving touch? How can we express something through touch? Could we even tell haptic stories? The purpose with these questions is to map the foundations of experience and to discuss how this mapping can lead to new knowledge and the construction of meanings of touch in an existential context. The scope of these questions is vast and their investigation will thus be limited to the methodological framework of how touch facilitates embodied experiences within the context of aesthetics and interactive media art installations. The goal of this investigation is not to give complete and extensive answers, but to contribute to the opening up of a field which has not received much attention. From an artistic point of view it additionally attempts to discuss how art and aesthetics as phenomenological fields can uncover dimensions of the complexity of touch.

Developing the perspectives on how haptic interfaces, such as my bodysuits, influence experience is the background for this chapter. The bodysuits have a real, physical, measurable effect on the wearer, but touch is not just a physical phenomenon. It has a strong cognitive dimension. As the section on nociception in section 3.2.3 pointed to, the feeling of pain occurs as a result of cognitive functions, not in neural bursts alone. This is an example of how we go from *sensation* as physiological activity to *perception* as conscious reflection. As Merleau-Ponty's notion of the intentional arc illustrates, there are also other sources that affect perception. The next section will for that reason discuss how different media influence how we experience and understand touch.

5.2. MEDIA AND OUR EXPERIENCE OF REALITY

With reference to the effect of the Gutenberg printing revolution, McLuhan pointed at the changes that happen when new media –such as TV during his time– are introduced:

The giving to man of an eye for an ear by phonetic literacy is, socially and politically, probably the most radical explosion that can occur in any social structure.’ -McLuhan, 1964:58.

According to McLuhan media extend our body. Media, and in the 1960s most notably the television, extended our bodies with global eyes. All of a sudden the viewer could see through a televised window what actually happened on the other side of the globe. With relatively few channels in the 1960s everybody was fed the same information at the same time. Watching TV therefore had a socially streamlining effect. TV had a powerful and significant effect as a transmitter of what could be perceived as ‘truth’, as *one* view was sent to *many* recipients. One of the aspects of new media such as Virtual Realities and the internet is that they include a two way connection between users. Similarly, transformation of our experiences through new media is happening continuously. The way we tell stories influence what we can experience. If haptics are introduced to and included in storytelling we can expect a literally *sensation-al* model for media that will influence subsequent narratives and perception.

Today every internet user can communicate one-to-one or even many-to-many. Examples of software facilitating this are ICR (chatting), Skype, Facebook, 3D avatar spaces like Second Life or Twitter. Seeing the development from the TV to Twitter, an extension of McLuhan’s statement would be the hypothesis that the dynamic communication space of tomorrow’s computer enabled media will have a greater affect on our culture than all previous media-revolutions together. This is a bold statement, but, as new media evolve they usually come as a natural extension and evolution of previous media. Therefore their possibilities, as in concepts for ambient intelligence (Riva et al., 2005) are likely to increase rather than diminish. The introduction of web 2.0 shows signs of the new forms of social communication that we are moving towards. The new use of computing is shifting towards social technologies (Lytras et al., 2009). This is socially different from the information retrieval-based activities of the early computing and web days. These issues are relevant to this research because of the novel forms of experience touching technologies bring. For example Ihde perceives a culture that develops a phenomenology of relations between humans, technologies and the world (Ihde, 1997:369-381). How will touch affect these relations?

In my approach to the embodied experience I have had several inspirations. As mentioned in chapter one, my career started with traditional material media like three dimensional figurative sculpturing and gradually moved towards the ‘virtual’ world of virtual realities. During my years as an artist there have been several art historical shifts in how art is experienced and progressively has become a matter of lived, direct experience. Interactivity represents one such media (r)evolution. It can be described as a mutual and reciprocal activity between two or more participants. With the widespread use of the PC and the Internet, interactive media has become a normal, everyday activity. This represents an evolution that changes the conditions of *how* we experience. It therefore also affects *what* we can experience. Recent developments include new perception manipulative technologies like web 2.0, the various social media associated with it and emerging mobile and wearable applications. As discussed both here and in section 3.4.1, our perception is influenced by coding and coloring due to cultural contextualization. To realize the potential of digital, time-based media to a larger extent, I have experimented with how it can be included and translated into real, corporeal experience. In this way McLuhan’s media-revolution has the potential to transform the experience of art and aesthetics from recording to rendering, observation to interaction, reflection to behaviour (Druckrey, 1996:23). The artistic experience then becomes a question of embodiment. An implication of tactile media like cyberSM is that the bodysuits enhance and channel users’ corporeal experiences. The users so increasingly find that their bodies become an integral part of the experience. How does this influence their perception? And how can we understand that from a theoretical point of view. To predict the influence of haptic stimuli there are several alternative models of perception.

5.3. MODELS OF PERCEPTION

The main argumentation will put emphasis on the phenomenological analysis and understanding of perception and touch. Before we so to speak position phenomenology in the field it might be relevant to see it in relation to some alternative views on perception. This section therefore gives a brief and condensed overview of relevant theories.

5.3.1. Body versus mind: Cartesian dualism

Descartes’ body-mind split, so-called Cartesian dualism, has played a significant role for the historical understanding of how perception functions. It has also influenced the way Virtual Reality has been understood. In, for example, the NASA VR illustration of the woman wearing a HMD (Figure 4-6), it appears as if technology has taken over the body. The body is reduced

to an object and appears passive relative to the ‘active’, ‘hair blowing’ medium.

As discussed in section 3.1, explanatory theories about the nature of sensory content have a history as long as philosophy. The Cartesian Dualism dividing ourselves into one body versus one mind has petrified our view of perception. Even if a simplistic reduction, his first-person method of introspection proposed a dualistic understanding of perception as the interaction between the two separate entities of the machine-like body as nature or physis, *res extensa* and the immaterial substance of the mind, *res cogitans*. According to this view, if I put my hand onto a hot oven, my body tells my mind that I am burnt. The other way, if I feel like having fresh air, my mind tells my body to go for a walk. For Descartes the split between body and mind is manifested through a passive body as an object for the active mind (Svanæs, 2000:87).

One model of thought that Damasio advances –and one way to think about body-mind dualism- is terming the arena of consciousness for the ‘Cartesian theatre’ (Damasio, 1999:11). This ‘theatre’ contains the active processing in which concepts interact and thoughts are juggled. A particular species of process in this theatre is that of filling-in, the process by which we perceive continuity of the world across regions with no neural response, such as the blind spot of each eye. This suggests that our consciousness is constructed (Fridenberg/Silverman, 2006:60). One problem of the Cartesian theatre is that it is hard to indentify the brain region where this happens. There is no specific function for this in the brain. Dennett (1991) has argued that there is no need for filling-in because the absence of stimuli input is not a positive indication of a lack of input. Within works on human haptic perception the so called *Tau* phenomenon describes a tactual illusion of apparent movement. When a series of short and discrete pressure sensations are produced on the skin, they are perceived as though they were produced by a single stimuli drawn continuously between the points (Grunwald, 2008:80 and :656). If we cannot find a mechanism in the brain that fills in this gap then this could be an indication that the filling in happens on another level, perhaps even in the body itself. A problem with the Cartesian Theatre is that it explains the filling in as if a little man was observing from inside our heads. This is the so called *Homunculus* (little man) problem. This cannot be, and as the Tau phenomenon indicates it does not need to be. If the filling in, for example, happens in the skin itself, then this is an indication of a ‘thinking’, partly autonomous body. Interaction between mind and body extends to cognitive activity, so that the skin ‘thinks’, or plays its part in cognition, outside of the brain.

The failure to bridge the gap between mind and body is often used as an example of Descartes’ extreme rationalism. As shown, and in contradiction to

how common notions of dualism is coloring our (cultural) perception of reality, it does not satisfactory explain the everyday sensations and experiences we have in our bodies. For that reason we need to escape the extreme version of dualism. However, it could also be that Descartes is preparing the ground for body-mind union down the line. For example in his philosophical treatise on optics, *Dioptrique*, he talks of how the blind can ‘see with their hands’ (Paterson, 2007:38). Here he opens up for the body (hands) to be perceptually equally important with the eyes and therefore indirectly with the higher cognitive functionalities. Also it appears that he valued the passions –love, hate, joy and sadness- as ways of protecting our embodied minds, helping us to stay alive and flourish (Sorell, 2005, 121).

The extreme dualist understanding of Descartes proves to be flawed thinking and an artificial construction. It is a false opposition we again encounter in VR when it is divided into real/actual/virtual. This division is wrong. We behave in the world as if there is no difference between *res cogitans* and *res extensa*. Our consciousness appears as more complete, as something embodied. Embodied experience is a matter not only of the complex interplay between brain and viscera, but as Antonio R. Damasio remarks (1994), also from the constant engagement of our embodied interactions with the environment (Hayles in Mitchell and Thurtle, 2004:220).

Merleau-Ponty foregrounds the flesh because it is of the body, and because the body is a part of the world. It is a Moebius type of relationship with one continuous surface. The world is folded into the flesh and the flesh is a part of the world (Merleau-Ponty, 1968). Phenomenology is therefore directly criticizing the extreme version of the Cartesian conception of the world. This opposition between dualism and embodiedness is at the core of this chapter. However, before we go on to that discussion it might be useful to briefly explain a few other views of perception, namely the empiricist conception, adverbial theory and Uexküll’s subject-oriented biology.

5.3.2. Classical empiricist conception and sense-datum theory

A majority of philosophers in the early modern period distinguished between the external object itself and the object formed in the mind of the perceiving subject. When I see a tree I am aware of an image of the tree, not the physical tree that exists independent of my mind. The immediate experience creates not a physical object in my mind, but an image, a *sense-datum* with the sensory qualities that I experience. This is called the classical empiricist conception of sensory content (Robinson, 1994). The notion that sense-data are the origin of perceptual objects is called the sense-datum theory. According to Howard Robinson (1994) a sense-datum meets five conditions:

- It is something of which we are aware
- It is non-physical
- Its occurrence is logically private to a single subject.
- It actually possesses standard sensible qualities, for example, shape, colour, loudness, ‘feel’ of various sorts
- It possesses no intrinsic intentionality; that is, though it may suggest to the mind through habit other things ‘beyond’ it, in itself it possesses only sensible qualities, which do not refer beyond themselves

There are two main arguments for this position, the argument from illusion and the argument from scientific account of perception. The argument from illusion states that as the sense-data varies independently of the object itself, there are good grounds to belief that the sense-data exists independently from the object in my mind. Examples of this is how the roundness of a coin becomes elliptical from all other viewpoints than completely perpendicular, and how the same bucket of water can be sensed to be both hot and cold at the same time – provided, for example, that one hand has been held in your (warmer) pocket and the other in the (colder) air before they are put into it (Jagacinski and Flach, 2003:271).

Critical questions to this argument have been that it could all be a sensory illusion. If there is an illusion no object need be present. Or, why do we need a sense-data object if illusion is caused by readily explainable misinterpretations of the (external) object? How long can such an object exist? Is it not just an extra mental (outside the mind) construct? Sense data cannot exist outside the mind.

The second argument for the existence of sense-data objects is the scientific explanation. No matter how much one alters the perceptions of the perceiving subject, the external object itself does not change. If one were to use drugs to affect the sense-organs and the resulting neurophysiologic processes, the sense-data of a perceived tree would change, but there would be no scientifically measurable effect on the tree itself. Also, the body is slow: the fact that sensory impressions need time to be processed by the brain indicates that what one perceives is not exactly on time with the external object. Therefore there must be a difference between sense-data and external object. Hence, the sense-data appears in the mind as an effect of various causal processes.

The nature of the immediate experience of an object has also been termed the act-object theory. When I experience something as something it is an i) *act* of awareness and ii) an *object* towards which this awareness is directed. A critique against this view is that it has no explanation of experience and can

therefore be described as naïve realism as, for example, Bertrand Russell points out:

As regards the world in general, both physical and mental, everything that we know of its intrinsic character is derived from the mental side, and almost everything that we know of its causal laws is derived from the physical side. But from the standpoint of philosophy the distinction between physical and mental is superficial and unreal.’ -Bertrand Russell.⁹⁸

As in the SeC project, the body is completely immersed in sensory impressions. Even if there is a correlation between what is seen inside the 3D immersive glasses and what is felt on the body, this connection is so abstract that one can hardly expect users to completely understand it after only about ten minutes inside the installation. This was the average usage time per user. To my observation it was instead as if users directly bridged the gap between audio, video and tactile information. The empiricist conception and the sense-datum theory do not appear to explain this corporeal ‘bridging’ of perception.

Perhaps philosophy through language can provide a better model for perception? Adverbial theory attempts to explain perception through an analogy inspired by our active use of language.

5.3.3. Adverbial theory

The adverbial theory argues that there is no need for an object. The sense-datum theory represents a slowness and obstacle towards a direct perception of the world. What if the sense-data is in the way of experiencing the world? It could as well be a veil of perception (Robinson, 1994:163) that hides our understanding of it. The adverbial approach wants to get rid of the sense-object and promotes the direct activity of perception (ibid, p. 174). Instead of talking of the *red sense-data* of an object, the adverbial theory turns sense data to internal accusatives promoting activity and is now perceived *redly*. The objects change from being red to be perceived red-ly. This directedness has made the adverbial theory a part of the intentional theory (ibid, p. 174). Where the weakness of the sense-datum theory is that it creates another object, the object of the mind, this is also its strength. It is a good description of how direct perception functions. The strength of the adverbial theory lies in its simplicity of being immaterial. Having no extension adverbial theory avoids having to explain how sense-data are constructed and where they are to be found or even communicated. For if data exist they can also be communicated. Adverbial theory is action-oriented, but how can we explain

⁹⁸ In Kegan, 1927:402.

what perceiving *redly* really means? And how can this explain perception of touch? As in the case of SeC, the user's reaction to the corporeal stimulation was highly physical. Their description of what they sensed tended towards causal explanations, like '*a snake moving on my body*'. Here the direct connection between 'body' and 'mind' becomes central, and adverbial theory fails to comprehensively explain this experience. Why is this? Through the perception of active qualities like 'redly', it appears that adverbial theory is about the immaterial. It is in this immateriality that the adverbial approach falls in the Cartesian gap, and the theory grinds to an uncertain halt. Adverbial theory cannot solve dualism through straightforward linguistic means. It appears that any theory to bridge the dualist gap needs the body as material reality.

As my observation of the SeC project indicates, perception is material and it appears in living subjects, therefore it also contains a biological dimension. In my experiments on touch this biological dimension is the human user's body. Uexküll introduced the subject into biological models. Both the adverbial and the biological model include active subjects. As will be shown later, these active subjects appear as an essential element in phenomenology.

5.3.4. Uexküll's subject oriented biology

The skin is our surface to the world. It is so to speak our primary interface. A much-debated issue is the question whether this surface is a passive receptor of stimuli or if it works as a two way surface of communication, interlinking the human with the environment beyond a causal, predetermined relationship. Related to this issue, Jakob Johann von Uexküll's (1864 – 1944) environmental research and his concept of subject-oriented biology is valuable.⁹⁹ Uexküll's ideas stand in opposition to biological theories influenced by Darwin. In his studies of nature he describes living organisms, including the human, as something more than reflexive machinery dominated by causal mechanisms and as a product of natural selection. According to Uexküll we can first understand the complexity of relations and adaptation in nature if we understand organisms as active subjects. Uexküll's environmental research made the subjective part of perception the starting and ending point in biology. His approach is to the phenomenon of life itself.

Uexküll explained through the life-world of a blood sucking *tick* how we shape our specific environment (Voss, 2006:159). The environment of a tick is threefold: firstly it knows through smelling odours whether it is above an animal, and if so, it then let's itself fall down. Secondly through primitive touch it can then sense whether it has landed on an animal or not. Thirdly, through the sense of heat it can differentiate between the colder, unsuitable

⁹⁹ <http://www.math.uni-hamburg.de/home/rueping/Projekte.htm> accessed April 11th 2010.

and naked, suitable spots of skin to bite. From a sensual point of view, the tick lives in an impoverished sensory world compared to the more complex human milieu. It is a lifeworld nonetheless. Every species live in their own environment and perceive it from the conditions at hand. This perception is more than a physical, chemical and thermal causal reaction to an environment, but rather indicates how species reacts from a semiotic point of view. The mammal (object) radiates certain signs as the behaviour of the tick (subject) is triggered by a selection of perceptual signs. Through the interpretation of specific signs in its environment the tick becomes an active subject (Bains, 2006). This is a reaction to the Darwinian reading of animals as passive objects of natural selection.

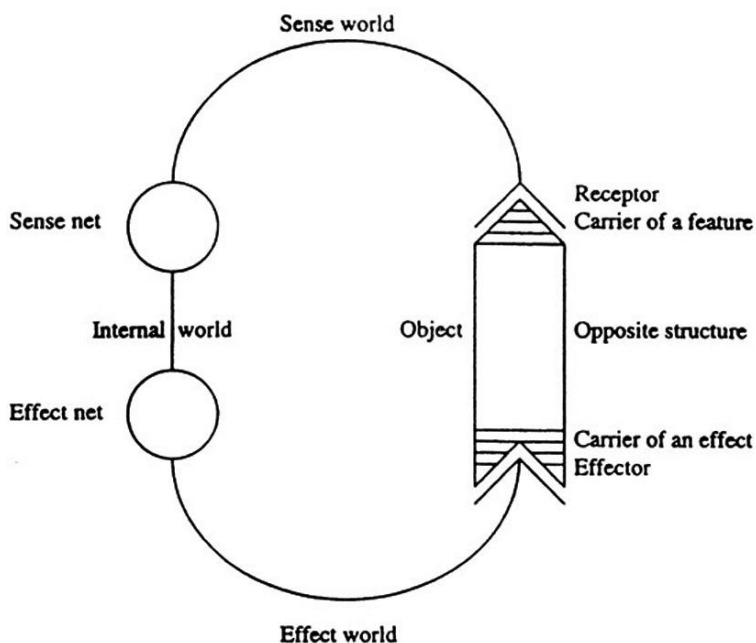


Figure 5-1 Illustration of Uexküll's Functional cycle, portraying the feedback cycle of the life-world (Rüting (2010)). © Wikimedia Commons.

As Bergson remarks (Bains, 2006:72) without language, that is awareness of the relation of signification, the animal (the tick) is held captive by its environment (*Umwelt*). As (human) beings in an *Umwelt* we can develop our own semiotics by playing with the relations that constitute it. Uexküll considers animals, including humans, as semiotically active in the sense of *Semiosis*: an action that involves the use of signs. Uexküll's work later influenced the terminology of *Biosemiotics*: the study of signs, of

communication, and of information in living organisms (Oxford Dictionary of Biochemistry and Molecular Biology, 1997).

Uexküll is interesting in relation to how active subjects perceive the world according to their biological constitution, thereby giving ground for a subjective semiotics. Considering the difference between animal *Umwelt* and human *Lebenswelt* (Deeley in Bains, 2006:75), humans can interact and play with pure relations. The *Umwelt* is like the web of a spider where the human subject spins his relations to selected characters and features of objects and connections around him (Bains, 2006:76). It is a semiotic web constructed by an active (language capable) organism. One interesting finding for the area of virtual touch is how Uexküll imports the notion of semiotics to perception. This might have consequences for the way, for example, a vocabulary of touch can be developed and perceived by users of various cultural backgrounds e.g. if Europeans would be compared with the Cashinahua Indians (section 3.4.1).

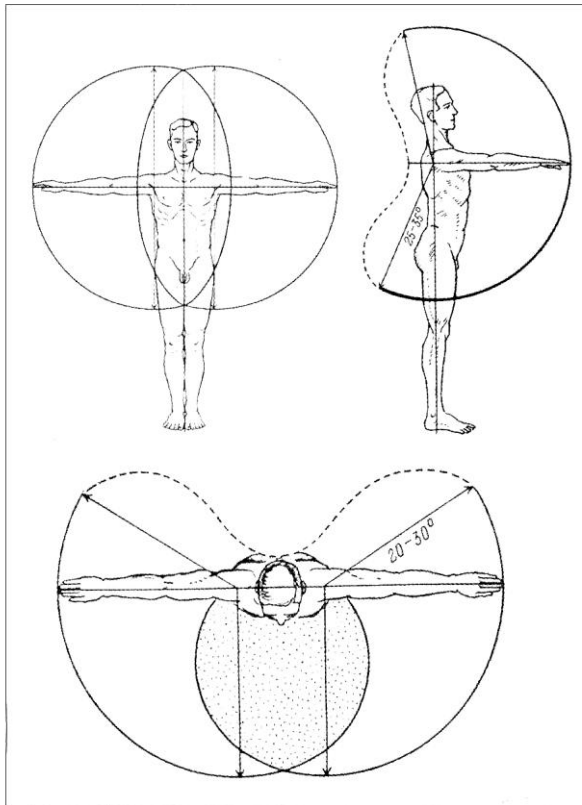


Figure 5-2 Haptic space after von Skramlik. © Source: Grunwald 2008.

Through his environmental research, Uexküll made the subjective part of perception the starting and ending point in biology. Without language we are, like the tick, held captive by our environment. Uexküll's focus on semiotics explains how we form meaning through the use of signs. His approach is pre-phenomenological, and relates to Husserl's notion of the Lifeworld. An interesting question is if biosemiotics enable us to better construct an artwork through the simulation of a Lifeworld?

Uexküll's concept of active area (Wirkraum), that is the range of the motion of our limbs (Janich, 1992:96), has inspired thinking about how we deal haptically with our environments. Skramlik accordingly developed the concept of *haptic space* (Grunwald/John in Grunwald, 2008:34). By describing how the extremities of the body move in a specific manner related to bodily axes and head, he observed the different tactile spaces of the limbs. By doing so, Skramlik was able to systematically explore how we haptically deal with and internalize space. His notion of '*Haptic coordinate system*' describes how the haptic space differs from Euclidean geometry at all levels. One example is the subjective positioning of the bodily axes when vision is removed. Objective placement and repositioning of objects are seemingly distorted by an internal 'haptic coordinate system'. As a single sense, the haptic dimension follows its' own logic. To be coordinated with the 'real' world it needs multimodal input.

These insights are relevant for proprioception i.e. the largely unconscious perception of movement and spatial orientation arising from stimuli within the body itself, and interesting in relation to the development of emotional expressions and emotional 'letters' through a given haptic language like the ones the Erotogod installation tried to construct (chapter six). A critical question here is to which degree the haptic coordinate system and active area is subjective. Could it be that such haptic experiences are too subjective to become intersubjectively understandable and communicable? It appears not as the variation between individuals can be fairly small in normal situations and positions of the body (ibid, p. 37). However, it should be taken into account that subjective perceptions exert influence on the range of haptic meanings.

Relevant for my haptic art installations is here the uncovering of how important internal and inwardly oriented perception is. As, according to Skramlik, haptic space is so differently perceived without visual stimuli, haptics emerges as a sensory dimension on its own. The *inter_skin* project exploits how the auto erotic selfstimulation can be used to cause a unique (internal) sense of experience once the visual dimension is removed or at least reduced (section 4.8.4).

5.4. THE WORLD AS A PHENOMENOLOGICAL CONSTRUCTION ZONE OF EXPERIENCE

To the sense-datum theory the colour red appears as a red object in the mind. The adverbial theory perceives the colour as an immediate and *redly* quality. For Uexküll's tick, red would have an environmental and therefore existential quality. For Merleau-Ponty we live our life through a flow of experiences, and in all the abundance of experiences, we would recognize a visible colour red as '*an ephemeral modulation of this world*' (1968:132). Like a hand touching the other hand of the body, the touch becomes both a thing and in-between things. Both the touching as well as the touched hand belongs to this world.

This goes against the commonsense idea of the world as a Cartesian split into 'mind' and 'body'. However, this division is, just like Aristotle's division of the senses into five separate faculties, or any other model, culturally learned and represents only one of many possibilities for understanding. The splitting of everyday life into zones of material reality versus immaterial spirituality seems, moreover, too ordinary a dichotomy. The phenomenological concept goes against this. In phenomenology the object of study is our experience (Smith, 2005). The colour red is then not in the object or in my eyes, nor is it in the brain, but it is a part of the whole environment. Phenomenology covers a field, trying to understand how we experience. As Heidegger's famous example of the hammer illustrates (section 5.4.5), knowing is not always a question of slow, steady, accumulative learning. We will only 'know' a hammer when it is broken down (Tester, 1994:6). Sometimes things in the world around us reveal themselves when they break down and thereby uncover the machinery behind the ordinary, or how we are situated and directed towards the world.

The following sections will discuss phenomenological concepts of perception, ascending from descriptive to prescriptive approaches.

5.4.1. Brentano: the first steps into the phenomenological approaches to experience

Phenomenology is not just a disciplinary field in philosophy, it is also a historical movement. It is beyond the scope of this thesis to describe the subtle differences between the various phenomenological schools. From the point of view of an art practitioner I will try to extract how the phenomenological approach in a general manner deals with experience and how this view changes—if it changes—the new world of electronic and interactive art. From an artist point of view, the nature of experience is interesting insofar as it reveals a view of the world that one is usually not aware of. The users approach to the world and how they react to it can also expose ways of measuring the affect of the artwork.

In its Germanic strand, phenomenology is usually traced back to Brentano. For him phenomenology was summarised as the relationship between mental acts and the external world. The 'I' has a particular and pointed psychological approach to the world that he defined as *intentionality*. It is the 'key concept for understanding and classifying conscious acts and experiential mental processes' (Moran, 2000:25).

Intentionality is the main difference between physical and psychological phenomena. All mental phenomena are directed towards an object. This he calls the intentional object. When we think about an object all our thoughts are pointed, that is intended, towards some external object. We are so set on the object that we *intend* it, hence intentionality. The focus of our intentionality can be an object out there in the world or an objecthood within, for example, consciousness.

All desires and beliefs are related to specific objects that again create intentional objects, i.e. objects of thought in the mind. Their status is described by the expression 'intentional inexistence':

Every mental phenomenon is characterized by (...) the intentional (and also mental) inexistence of an object, and what we would call (...) the reference to a content, a direction upon an object (by which we are not to understand a reality...), or an immanent objectivity. Each one includes something as an object within itself, although not always in the same way. In presentation something is presented, in judgment something is affirmed or denied, in love [something is] loved, in hate [something] is hated, in desire something is desired, etc. This intentional inexistence is exclusively characteristic of mental phenomena. - Franz Brentano (1973).

This appears confusing. Objects of our consciousness seem to have either physical or mental nature. What are their differences? Objects of consciousness are mental, but may have a physical source. Is it here implied that the physical relates to the outer perception and the mental the inner perception? Or is it that the mental phenomena are somehow unified (Moran, 2000)? These distinctions appear unsatisfactory for Brentano, at least as long as the object is immanent in the *act*. Physical phenomena are not intentional and do not refer to anything beyond themselves (ibid, p.53). Yet, these physical phenomena can be grasped in the mind as colours, figures, specific sounds, warmth, cold etc. These are sense qualities and not external objects. Our intention is directed towards physical phenomena. We do know the world through our sensory impressions. The *acts of inner perception* have actual existence as such (Husserl) (ibid, p.54). The content of these (active)

acts is passive and sense content is therefore only phenomenally and intentionally existent. Acts of outer perception, like seeing, are able to grasp themselves, i.e. through self-reflection the subject realizes she or he is seeing. This as an act belongs again to inner perception. The outer perception therefore appears as a special instance of inner perception.

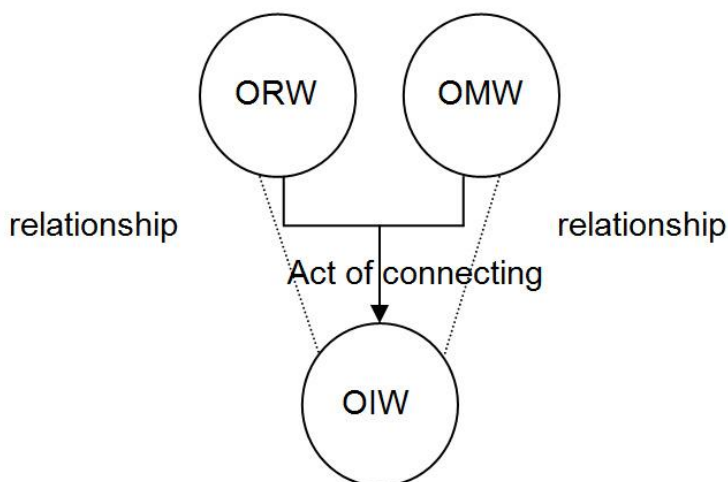


Figure 5-3 Graphic presentation of the relationships between Object Real World (ORW), Object Mental World (OMW) and Object Intentional World (OIW).

Brentano's use of the word 'inexistence' comes from the Latin term *in-esse* (Moran, 2000:48), the verb meaning 'to be in', in being, to actually exist. This could mean that Brentano in fact means that there is a mental object in the mind. When I think of the moon, does this mean that the object of my thought is not the moon, but the thought about the moon? (MacIntyre, 2005:24). It seems so, i.e. thoughts about objects have a certain form of existence in themselves. Also, when this happens, we 'intend' that object, hence intentionality. The moon is intentionally existing in my mind, but what is unclear is whether one can see it as a real object (of thought) or not. Brentano's understanding of intentionality is that it describes how mental states can refer to elements of external reality (Dourish, 2004). It concerns the moon hanging in the sky and *my thinking* about it.

Brentano's student Twardowski explains intentional inexistence as 'phenomenal existence'. According to this the moon exists also as a mental object. All mental states have the property of being *about* something

(Dourish, 2004:105), and it is the nature of this about (Aristotle's *peri ti*), i.e. *the relationship and the act how these states are connected with something* that Husserl was to elaborate further.

This is related to my artistic research projects in that the users are set in a physical context so intense that an immediate reflective thinking about the sensory experience is made hard to separate from the holistic sum of impressions.

5.4.2. Husserl and the sensory Lifeworld

Husserl saw phenomenology as a method for exploring the nature of human experience and perception (Dourish, 2004:104). The task of phenomenology as he saw it was to explain how human beings have knowledge of the world. Accordingly *phenomenology is about the way the world of our experience is constituted for us* (Krois, 2007:29).

According to Føllesdal,¹⁰⁰ Husserl further developed Brentano's concept of 'intentionality'. All consciousness activity is, according to both Husserl and Brentano, consciousness about *something*. According to Brentano this something is the object of the 'intentional part' (*Bestandteil*) of being actively conscious (Føllesdal, 1978:87). Phenomena of consciousness always contain such intentional objects. The notion of intentionality implies that the main characteristic of consciousness is that it is always intentional. It is never blank but pointed and directed by a sum of influences

The question in terms of experiencing the world is how the intentional object is constituted. For Brentano intentionality meant directedness towards some object which is always there (Føllesdal, 1978). He used the phrase that the object 'intentionally *inexists*'. As mentioned, this has caused a lot of misunderstandings, but it appears that what Brentano pointed towards was that the real physical object and the intentional object were different things. When I think of the moon I think with the idea of the moon in mind, but this is clearly different from the object moon (Føllesdal, 1978). The question remains however, how intentional objects can have a shadowy existence separate from reality? How does one explain this gap in consciousness? To answer these questions the following phenomenological approaches turned to lived experience.

Husserl's key research in his work *Logische Untersuchungen* concerns the structure of consciousness. Here he makes the distinction between *noesis* and *noema* (pl. *noemata*). We must distinguish between the act of consciousness—which he calls *noesis*—and the phenomena at which it is directed, the *noemata* (Føllesdal, 1978 and Dourish, 2004:105).

¹⁰⁰ Dagfinn Føllesdal in vgl. Bd.I, Kap. I u.II *Konvergierende Tendenzen in der heutigen Philosophie*.

The noemata have an ‘as if’ structure - our consciousness works as if there was an object. Noemata are phenomena at which consciousness is directed. By studying *noemata* we also study and explain different features of our consciousness—epistemological, aesthetical and moral, for example. This is in essence the explanatory part of phenomenology

This study also reveals what could be the features of one object (Føllesdal, 1978:89). These features are objective in the sense that a round table still can be said to be round even if it is seen from another perspective than the top view. Some features of an object can therefore be said to be the same, regardless of how we perceive it.

These general material effects on our experience is what Husserl calls ‘*hyle*’ from the Greek word for matter (Føllesdal, 1978). *Hyle* appears when physical objects activate our sensory organs and therefore *hyle* can be regarded as a kind of mediator between the noemata and noesis. The more *hyle* (material activation) we gather, the more it will affect the noesis we have. Together the noesis, the noemata and the *hyle* are components that direct our consciousness towards objects (ibid). The notion of *hyle* is an interesting concept for artistic experiments. By changing the material conditions of the experience -such as sound, sensation, visual appearance - the notion of *hyle* could provide an instrumental approach to directing our (intentional) perception.

The centrality of perception for human experience takes place in what Husserl calls the *Lifeworld*. The term signifies the entire worldly background and starting point for human experience and reflection. Hence real, ordinary and even mundane daily praxis is an essential element of the Lifeworld (Dourish, 2004:106). Ihde points out:

Husserl seems to be saying that the Lifeworld is, and must be, the sensory Lifeworld, based in the relations between actional humans and the concrete, material world of things and beings, which are bodily’ (1991:21).

Phenomenology rejects abstract and formalized thinking (Dourish, 2004:106). It is in the everyday experience that we’ll find the answers: ‘*The Lifeworld is that structure of experience which is both perceptual and historical*’ (Ihde, 1991:22). This paves the way for a synergistic perception found later in the writings of Merleau-Ponty.

According to Husserl all our intuitions of the world are constituted, not given (ibid, p.22). We constitute objects in that we are intentionally directed toward them. And the Lifeworld is the arena for the complex interplay of intentional experiences. Husserl’s phenomenology so describes how objects are perceived and how our perception actively constitutes them.

5.4.3. Haptic art and the Lifeworld

How does this contribute to the design of better touch systems? To better understand the bond between art and experience it is useful to look to Husserl's notion of the Lifeworld and its relation to the sociological filters of perception and the instrumentalized use of physical art as tools to think with.

Husserl can be said to be a foundationalist with the view that all experience is founded upon some core or original human praxis and perception. At the same time this view indicates a general openness towards the sensory role of the perception in the world. If art influences the way we are seeing the world, then art can be described as a filter for our experience. As a filter it allows for certain phenomena to be experienced, and others not. In such a selective approach art can be employed in an instrumental manner for changing social experiences and individual, corporeal perceptions.

This explains my approach to art exemplified in the *cyberSM* project. It is an artistic case of existential phenomenology in that it sets the user in a corporeal, *storytelling* situation where the immersive, embodied sensations are results of the social relationship to the other (online) user. Through the employment of sado-masochistic (S&M) aesthetics and the corporeal stimulations associated therewith, the installation became a *simulated*, but nonetheless an encompassing *Lifeworld* structure that filtered and manoeuvred embodied experiences, directing them towards a particular construction zone for impressions. My use of S&M signs is relevant to Uexküll's application of semiotics to understand, explain and influence perception. It appears that mastering and composing the external (biosemiotic) signs surrounding a work of art have a real impact on the user. This positively answers the question of section 5.3.4 if semiotics contributes to the construction of an artwork through the simulation of a *Lifeworld*.

If the concept of *Lifeworld* is understood to be the sum of the interaction between body, mind and external world in such a manner that there exists no clear division, but a continuum of 'being', then the world is a part of the body. The phenomenological subject can be understood through its immersion in the world (natural attitude). Merleau-Ponty explained the world as what we perceive. It is a perceptual something that is always in the middle of something else. It always forms a part of a field, a perceptual field. The world is something I experience as an incarnate or embodied being. The body can hence not be separated from the world, but they must both be taken into consideration when we account for the human situation.

5.4.4. Social and cultural influences in the Lifeworld

As discussed in chapter three, culture plays an active role for perception, influencing it through cultural habits. An example of this is the regular *White*

Cube context in which most visual art is exhibited. This refers to the artificially clean presentation context as found in art museum and galleries (O'Doherty, 1999). From a sociological point of view, White Cubes forms impressions and influences all participants from the moment they even hear about the exhibition. In this sense all viewers meet artworks with at certain preconceived expectation. In terms of Bourdieu's *habitus*, that is the habitual nature of embodied actions (Hayles, 1999:2002), the White Cube function as a social and cultural filter, a temporary Lifeworld that sets the perceptual 'horizon' that creates and satisfies expectations. Visitors are pre-coded by the social context to what they are going to experience. Artworks that are set in the social setting of an exhibition will always be part of a social coding of perception. The degree of 'cooperation' between the artwork and the exhibition context influence visitors' perceptions. This is significant for my own installations that resemble phenomenological experiments to test out ideas about the hermeneutics of sensory encounters with the world.

In his book *The Hidden Dimension* (1990), Edward T. Hall introduces the idea of proxemics and how our use of space affects us. His notion of the precultural behavioural pattern refers to the physiological bases for perception, yet '*nonetheless relies on culture for structure and meaning*' (Malnar and Vodvarka, 2004:149). This underlines the close amalgamation between the interdependent factors at play in multimodal experiences.

In the context of my own experiments and Husserl's notion of the Lifeworld, the Erotogod installation provides an immersive environment that forces the participant into a perceptual field where she or he takes part in an unfamiliar (cultural) process. This unknown experience could be seen as a 'cultural catapult', exposing the user to a 'paradigmatic' shift in relation to how sensory information is culturally filtered. The 'newness' of such a perceptual experience is counterbalanced through what Ihde refers to as the structure of experience (Lifeworld) that is historical. For instance in the 1990s the immersion into virtual realities were of high cultural fashion. At exhibitions like Ars Electronica these were treated like new art forms. Now, almost twenty years later this focus has shifted towards, for example, social online technologies like web 2.0. Social change has replaced the individual immersive experience as one of the new media culture slogans. In this way our experience is influenced by a culture's fascination for –and focus on– specific media possibilities, for example, the 'Geo-Observatory' of Ars Electronica with multi-screen interaction and online, social networking.¹⁰¹

A critical question is if the Erotogod art project can expose new differences in the experience of phenomenological immersion. How does the material condition of an art installation influence perceptions in the

¹⁰¹ As the Ars Electronica Center is described in the 80+1 project, <http://www.80plus1.org/about/introduction> accessed on April 11th 2010.

Lifeworld? How does it influence the possibility for identifying and testing a haptic language? As the discussion on the psychophysical dimension in chapter three points at, the material conditions of a multisensory art work (including sound/visuals/touch) frame and set a multidimensional, perceptual arena of the user's Lifeworld. The artist's role as an engineer of multidimensional experiences hereby is unique in that she or he controls the material conditions that possibly make users interpret the world differently. This opens up to the interpretative method of hermeneutical phenomenology and to the question of how material conditions relate to the user's experience. As Heidegger would show, when a hammer breaks down, we are confronted not just with a dysfunctional object, but with an ontic materiality significant for our situation in the world. This leads towards Heidegger's interpretation of the Lifeworld-concept.

5.4.5. Heidegger and hermeneutic phenomenology

Phenomenology becomes hermeneutic when its method is taken to be *interpretive* rather than purely descriptive as in transcendental phenomenology (Neville, 1987:61). *Hermeneutical phenomenology* as a method is set forth in Heidegger's *Sein und Zeit* and sees human existence as interpretative (Moran, 2002:245). My interest in Heidegger is motivated by his expansion of the hermeneutical act of interpretation to deal with existential understanding. How does this for example influence user's understanding of a haptic language? This section intends not to give comprehensive description of hermeneutic phenomenology, but to extract the essence of how it can be used to frame how artistic works affect perception. Portrayed by Ihde, Heidegger adopted the realistic notion of intentionality from Husserl. '*In the ontological sense, intentionality is the relationship between all consciousness and its world or domain of objects within a field*' (Ihde, 1991:49).

Heidegger's existential shift was to go from the Husserlian '*ego conscious of the world*' to the *Dasein*. In its ordinary German use *Dasein* means *being there*. Thereby the human perceptual situation is both fluid and ambiguous. This is a phenomenological relativity dependant on the fleeting condition of the living flesh, and influenced my works and the bodysuits in particular. If for instance the teletactile cyberSM installations are taken out of their context they will lose their social-active dimension, and they are reduced to physical sculptures¹⁰² without relevance for the existential dimension of *ready-to-hand* experience (Heidegger, 1978:101). This *ready-to-hand* (*Zuhandenes*) experience is in many ways connected with Heidegger's discussion of tools. Tools-at-hand are, as in his hammer example

¹⁰² One of the first cyberSM bodysuits has been permanently exhibited at the Museum of Sex in New York since 2002.

(that will be discussed in depth in the next section), something in-action, something of a natural extension of the human being, the *Da-Sein*. If something is destroyed, stands in the way or is not usable any more, Heidegger says that the mere *present-at-hand* (*Vorhandenes*) (Heidegger, 1978:67) character of the ready-to-hand appears. The ready-to-hand is connected with tacit knowledge (Polyani, 1983) of and in an ordinary situation. This ordinariness is one of the differences between Husserl and Heidegger. Where the subject in Husserl's phenomenology is of transcendental character, Heidegger focuses on the ordinary and everyday life situations. It is in the simple, day to day situations that the being is situated. '*Man muss da sein*' (you have to be there) describes that you actually have to be there to be at a certain place to experience 'it', whatever event 'it' refers to. The *Dasein* of Heidegger means 'here-being' and is used to describe our *Being-in-the-World* (Heidegger, 1978:145). We are always bodily present, in a situation, in a world. This marks a shift from Husserl's earlier phenomenological approach. Husserl's notion of the Lifeworld is still marked by being transcendental and remote. To Heidegger the world is what is immediate, proximate and 'to hand'. At the same time Heidegger develops Husserl's concern for the immediate and familiar. We must look at what we do every day. This everydayness hides existential and ontological implications. Looking at our ordinary activities, our daily actions, we see that they are not marked by explicit acts of knowledge, but by pragmatic approaches involved e.g. through the use of equipment. We deal with what is closest to us in a practical and unspectacular manner. In our everydayness we experience the world in a transparent, natural way. This is also the 'natural attitude' (Kockelmans, 1994:23).

One of my artistic goals is to develop a better understanding of the user experience when she or he is 'being there' - immersed in multisensory environments. How can I hermeneutically interpret both my own and others experience? What does the haptic immersion of bodies in immersive environments actually mean or reveal? Doing this by constructing art installations might seem a bit odd. Artistic installations and environments more often than not represent an unnatural experience far remote from *everydayness*. Upon entering an immersive installation, dressing in techno-gadgets, the users are given an instrumental technology for a—most likely unusual—corporeal experience. As commented on the future of computing in chapter one, to make users behave naturally and perceive naturally as they do in their 'everydayness', current interface design aims at building transparent technologies. Transparency, in an ergonomic sense and from the point of view of the usability aspects, is here used to describe use of tools and technologies that is experienced as easy and natural. This transparency and ease of use is important for users experiencing comfort, and the more

transparent a user interface is, the better it is considered to be. One condition here is of course that an interface actually does something. A window is, for example, transparent, but not directly affecting visual perception. Looking through a transparent lens however, influence perception through its optic distortion.

This concerns crucial haptic, artistic and ergonomic aspects of my work. What happens when they disturb the 'natural attitude'? Bodysuits in use represent technological interfaces that can be seen as 'Zeug' (Heidegger, 1984:68), accessible things, which are the *ready-to-hand* (Zuhandenes), not the *present-at-hand* (Vorhandenes) (Ihde, 1991:51). Their experience is not a task of exact science, but a question of corporeal interaction. The '*Dasein*' within such installations is not something to observe, but something the participant live. The user is intentionally directed towards the world. If, as Ihde states above, intentionality is about the relationship between consciousness and its world (Ihde, 1991:49), what happens when one's world 'breaks down'? A solution to this issue implies that hermeneutical phenomenology can be used as a tool to frame artistic works affect on perception.

5.4.6. Heidegger's hammer breakdown

Our directedness towards the world is revealed through our use of technology as in Heidegger's example of the hammer (Heidegger, 1978:98). When I have a hammer in my hand and hammer on a nail, then the hammer does not appear to me as a separate object. It does not exist outside of my immediate perception. It is at first not an epistemological object that I analyze into all its various textures, colours, weight and shape. First of all it is '*an embodiment which extends some human activity into its pragmatic context within an immediate environment*' (Ihde, 1991:52).

In *Being and Time* the hammer example can be used to illustrate the concept of breakdown:

..., when something ready-to-hand is found missing, though its everyday presence has been so obvious that we have never taken any notice of it, this makes a *break* in those referential contexts which circumspection discovers. Our circumspection comes up against emptiness, and now sees for the first time *what* the missing article was ready-at-hand *with*, and *what* it was ready-at-hand *for*. - Heidegger, 1978:105.

It is the *break* in referential contexts to Heidegger's quote above that is what I consider to be the occurrence of a *breakdown situation*. Due to translation, the term 'breakdown' itself only occurs one time in the English translation of

Being and Time (1978:188), but it is a common understanding that breakdown is one of the essential concepts (Dourish, 2001 and Øverenget, 1998:4). In the case of breakdown, the hammer becomes *un-ready-to-hand* (ibid p. 103 and Guignon, 1983:101). It is only when a breakdown situation occurs –as when the hammer breaks– that the hammer appears to me as something separate from me (*vorhanden*). Only then does it appear as a hammer. This is a crucial existential moment where the *Dasein* has to re-reflect on the relation to the World. The *Dasein* perception of *res extensa* is broken down. As a broken, dysfunctional ‘thing’ the hammer triggers new reflections. These can be epistemological (how to understand how it works), instrumental (how to fix it) aesthetic (the appearance) or moral (do I even need it).

In terms of gaining ‘knowledge of the Self’ (*Selbsterkenntnis*)(Heidegger, 1978:186) one must see something that has become invisible about the subjects. That which we do not see, the invisible is the ordinary, the everyday (*Alltägliche*). To make the invisible visible, we must break *out of* the everyday, break out of the ‘natural attitude’ (as mentioned in previous section) to see what goes on in it. The breakdown in everyday use provides the *phenomenological reduction* with evidence (Øverenget, 1998:4). This reduction means ‘leading phenomenological vision back from apprehension of a being, to the understanding of *the being of this being...*’ (ibid, p. 111). To *see* this we need to have a *pre-ontological* experience. This is what we get through breakdown, either through breakdown of objects (hammer) or as the later Heidegger saw it (ibid), through breakdown in the subject (for example through anxiety/*angst*).

The breakdown scenario forces a re-set of the perception. As Dreyfus says, with *disturbance* a new way of *Dasein’ing* comes into being (Dreyfus, 1991:70). It so to say sharpens intentionality. In order to build a new ‘*zuhandenheit*’ with the world we must enter into a new relation to the thing. In an aesthetic context this can be seen as a creative opportunity, as a chance to rebuild a new view of the world. It illustrates well how the phenomenological perception is a continuous process. We learn to use tools, forget them during use, and rediscover them once they break down. We become aware of the world through the disturbances that breakdowns represent (Winograd & Flores in Svanæs, 2000:47).

The hammer example has practical implications for the way one studies user perception. It should be possible to observe and describe user behaviour during actual breakdown of the hammer engaged and in use as an object-at-hand or ‘ready-at-hand’ (*zuhanden*) (Ihde, 1991:51 and Dourish, 2004:109). Broken down the hammer becomes dysfunctional, disengaged and ‘present-at-hand’ (ibid) (*vorhanden*).

Even if Heidegger talks about corporeal aspects as in the hammer example, the description of the body itself is not central to Heidegger in *Being and Time*. The *Da-sein* is described as a general description of any living subject's existence in general in any world (Svanæs, 2000:88). As Heidegger says (S&Z, 1984:143) 'the World is 'there': and its Dasein (being in the world) is its *In-Sein* (being-inside-it)'. As with Husserl's Lifeworld, we are immersed in it, with all the encompassing issues and implications this has. But where is the human body? The body acts as a reference to where I am, and whereto I am directed. After all it is my body that gives me a direction in the world. It is the body that tells me what is up and down, left or right, back or forth. It is our navigational vessel, without which I am disoriented (Svanæs, 2000:88).

Relevant for my work on haptics is to develop an understanding of the Dasein's specific body in all its material/corporeal complexity. Through the hammer scenario Heidegger developed what Ihde calls *existential materialism* (Ihde, 1991:55). It is an inversion of Platonism in that it is through the material object that the Dasein is exposed to Being-in-The-World. This material-based 'wake up call' is highly relevant to my artistic concerns to develop an understanding of the founding material conditions of perception. Even if examples like the hammer brought embodiedness back into the body/mind split, the human body still retains a character as an object for the Dasein, and not as a founding premise of perception. According to Bernstein (1983:12) Heidegger raises the profoundest questions about the very idea of transcendental phenomenology. But even if his hermeneutic phenomenology includes a stronger notion of materialism, he focuses more on accounts of the phenomenon obtained from mental material as literature, poetry etc. than the body. As Dreyfus notes, it is as if the body does not belong to the *Dasein*'s essential structure (1991:41).

As discussed in section 2.3.2, much like a broken hammer, transgressive art that breaks with traditional art making can be seen as a phenomenological break down of the instrumental use of art. This causes reflection on the very nature of art, paving way for new forms of art practice and knowledge building. Action-based behaviour will at some point implode, either physically or cognitively. When this happens it triggers reflection and, as Merleau-Ponty will show, it takes us to where the action is, namely to the body.

5.4.7. Vygotsky's breakdown

Another view on the breakdown scenario was developed separately by Vygotsky and contributed to what became known as activity theory. In general this is a psychological theory aimed at understanding the mental capacities of a single human being (Carroll, 2003:298). To analyse and

understand the individual one looks at the cultural and technical mediation of human activity. According to Vygotsky, human activity has three fundamental characteristics: it is directed towards a material or ideal object, it is mediated by artefacts and it is socially constituted within a culture (ibid, p. 299). Interesting here for the later discussion on Merleau-Ponty is how Vygotsky places the human into complex set of interrelated characteristics. Human activity according to Vygotsky has three levels: activity, action and operation. Relevant for the hammer scenario is here how an operation can become an action through conceptualization in breakdown situations (Bødker, 1991). Where the hammer breakdown creates reflection for Heidegger, Vygotsky sees it as a trigger of reflections in the user.

Vygotsky's work inspired the development of Activity theory (Bødker, 1990). According to this, when an action fails to produce the anticipated result a breakdown situation occurs. The operations of the actions then become conceptualised. The uncovering of such conceptualisations will therefore represent interesting findings in order to register if a break down situation has occurred. If the participant has become aware of such events in my experimental set up, it is a heightened awareness engagement. Yrjö Engeström uses Activity theory to propose that new forms of activity are generated by contradictions in and between existing systems of activity (Tuomi, 2002:116). When tools are exchanged, introduced or even broken down, they effectuate change in the activity. This change may trigger learning processes much like Dewey's experimental learning and Schön's reflective practice (ibid). Due to the complex interaction between the involved characteristics, activity systems are fundamentally marked by contradictions.

One criticism of Vygotsky and Activity theory is that it represents a materialistic approach to the problem. It is still a problem how it can explain, or be used within, the practical-aesthetical field where aesthetic issues beyond the practical often dominate. Both Activity Theory and Schön's description of the reflective practitioner offer possibilities of dialectic approaches to action. For both strands developing knowledge is action-based. However, Schön's '*knowing-in-action*' and '*reflection-in-action*' (Schön, 1983) are more focused on an epistemological crisis to be solved by a gradually developing discourse rather than the more abrupt perceptual breakdown leading to heightened awareness.

Relevant to my research is how various forms of breakdowns influence the users' experience of the interface. How transparent is the system to the user, and what happens when his/her activity is faced with a change due to breakdown of either material conditions, introduction by new elements or simply malfunction? The breakdown scenario is relevant to my research in particular when it deals with the body and how it is autoerotically used as a

touch interface. This embodiment of the interface, that is the introverted making of the user into an interface, is a challenging situation for our normally extroverted perception. To better investigate the practical implications of embodiment in perception, the next section looks at Merleau-Ponty's corporeal philosophy.

5.5. MERLEAU-PONTY: WORLD THROUGH BODY PERCEPTIONS

Phenomenology studies what is directly given to perception (Patrick A. Heelan in Neville, 1987:61). We have a tendency to undervalue embodied knowledge.¹⁰³ Merleau-Ponty extends the role of the body in phenomenology and puts it right at the centre. As in most modern phenomenology Merleau-Ponty's starting point was the work of Husserl. In his work he tries to refute the western intellectualist and idealist understanding of perception. Central to his works is to bridge the dualist opposition of body and mind by proposing the body as the *embodied ground for all perceptions* (Svanæs, 2000:89). During the development of his philosophy he arrived at a rephrasing of Husserl's 'All consciousness is consciousness of something' to 'all consciousness is embodied consciousness'. The bridging of the gap between body and mind was at the locus of his thinking. The world in which we live is of the body, and the body is of the world. This is a different approach from that of the philosopher he so often relates to, namely Descartes (Kockelmans, 1994:123). Already in the introduction to *The Phenomenology of Perception*, Merleau-Ponty attacks Descartes' lack of bilateral relations between the subject and the world. If Descartes split our world in the body and the mind, Merleau-Ponty reconciles them by stating that '*to be a body is to be tied to a certain world*' (Merleau-Ponty, 2003:171 and Stewart, 1998:170).

There is no opposition between body and mind. As he says '*our body is not primarily in space: it is of it*' (Merleau-Ponty, 2003:171). There is therefore no cold body that is completely controlled by the (homunculus) mind. Perception is always embodied and does not exist by itself. He states that '*the perceiving mind is an incarnated mind*' (Merleau-Ponty, 1964:3). This statement insists on the primacy of lived experience. Also he says, '*the world is flesh*' (Merleau-Ponty and Baldwin, 2004:255). According to this, living in the flesh, living in the here and now, is at the locus of the phenomenological process. Experience is a living thing, not something that can be canned and conserved outside the corpus. In framing the body as the main hub of the Lifeworld he makes perception foundational (Ihde, 1991:24):

¹⁰³ John Thackara http://www.adobe.com/uk/designcenter/thinktank/tt_thackara.html accessed on April 5th 2010.

'*The body is our general medium for having a world.*' (Merleau-Ponty, 2003:169 and Svanæs, 2000:89).

The body perceives as a living object, not as a passive receptor. Moreover, according to Ihde our intentionality is not only perceptual, it is also action-directed (1991:24). There is therefore no perception in itself. Perception is constituted by living in the world. The perceiving subject is always changing, always being born again. Consciousness is a lived experience, it is perceptual, in a state of flux and therefore the certainty of perception is always changing within lived experience. It must continuously be confirmed. There can therefore be no Cartesian *Deus ex Machina* or a God to grant me life-after-death, no guarantee that there is any meaning outside of the immediate of bodily experience. The immediate 'now' of the body is what Merleau-Ponty calls the 'I can' rather than the 'I am'. What does this mean? Embodiment for Merleau-Ponty indicates a mutual experience between the body of the perceiver and the body of an object. This has far-reaching consequences outside of theories of perception. Applied to the history of ideas, we see that if consciousness is perceptual, then *the certainty of ideas is based on the certainty of perception* (Lechte, 1994:30). In relation to this philosophy of life, Ernst Cassirer does not quite agree with the Heideggerian view that if *Dasein* moves away from the 'immediacy' of life that makes it so authentic, then it becomes unauthentic (Lofts, 2000:206). The 'immanence of life' must somehow be reconciled with the 'transcendence of the idea' (ibid, p. 206). For Merleau-Ponty, however, the soundness of ideas requires phenomenological investigation in a world that '*is what we perceive*' (Merleau-Ponty, 2003:xviii).

The essence of perception for Merleau-Ponty is not that it is the truth, but it grants us access to the truth (Ihde, 1991:24). According to this truth is some kind of relational condition. This represents a reading of it that stands in relation to when he says that '*perception is the background from which all acts stand out*' (Merleau-Ponty, 2003:xi). In existential phenomenology, existence is never isolated. It happens within a relational field and through complex interferences. Merleau-Ponty states that reflection appears *through* the body in a truly creative act of a changed structure of consciousness (ibid, p. xi).

The view of the body as thinking has consequences for the embodied interaction techniques of artistic experiments. Addressing the body through corporeal interfaces and with haptic expressions –as in my work– is consistent with the phenomenological process. Practically speaking it introduces the user's perception of sensory immersion as an important measurement. All tactile perception involves a bodily component. If I am going to induce an object into the user's sensory experience, this object must be positioned in relation to '*the cardinal points of the body image*' (Merleau-

Ponty, 2002:367). This is the ‘positional’ placement of an object as perceived by the subject. This appears similar to Penfield’s bodymaps (section 3.3.3).

To perceive a tactile object—according to Merleau-Ponty—it is not enough to exert a pressure. Pressure without movement does not feel like touch. Some tactile phenomena like roughness and smoothness, disappear completely if the ‘*exploratory movement is eliminated*’. Touch must also have the vectors of movement and time. These are important phenomenal components of tactile data. In designing the haptic language and expression of my art projects these components will be essential. Another critical question is the sensory resolution of the haptic interfaces. The bodysuit of the *Solve et Coagula* project demonstrated that it is much easier to create impressions of touch with 120 zones of touch than the 16-zone resolution of the bodysuit of my *sense:less* project. As I will return to in the section on haptic vocabulary (section 6.5), haptic resolution can be defined as the number of stimulants triggered according to patterning of movement over time. If a haptic language (expression) can affect the structure of consciousness, then the technological system in use is required to have a resolution where users feel ‘embodied’ and included, i.e. immersed in a system. With sufficient resolution such a system could present a new perceptual horizon in the Lifeworld and become a significant contribution within the complexity of the ‘intentional arc’.

In relation to saying that our body is our medium for having a world, Merleau Ponty continues: ‘Sometimes,..., the meaning aimed at cannot be achieved by the body’s natural means; it must then build itself an instrument, and it *projects thereby around itself a cultural world*’ (2003:169, my emphasis). Merleau Ponty’s ‘projection’ of the body implies, from my point of view, not the mere construction of an instrument or object, but a bodily adaption to a culturally constructed situation as well. Thus, a cultural construction is also a *story* of an embodied situation. This indicates that constructing and telling stories can be a critical part of perception. We are active in the world through telling of stories. Hence being in the world involves some kind of storytelling, not just through words, but also through the body. Storytelling comes into the Lifeworld when we tell stories through and with the body. My haptic art projects as SeC and Erotogod (chapter six) cause temporal and spatial situations that allow physical *spontaneity*.¹⁰⁴ The body represents here its own *agens movens* spurring a drive for ‘action’ and experience. Such *spontaneous narratives* indicate how the body tells stories to communicate with the world. The SeC and Erotogod projects adapt and influence the narrative structures of the Lifeworld by allowing users to corporeally unfold and to tell new stories in the Lifeworld through their body.

¹⁰⁴ Etymologically from Latin *sponte* (sua) meaning ‘of one’s free will, voluntarily’.

Such *haptic storytelling* (section 6.9) in the Lifeworld meets the need to be present in the world. Three moments are here important: *first* of all initiating storytelling through touch, *secondly* showing how haptic stories can be simulated and, *thirdly*, constructing actual (artistic) stories. The Erotogod project (chapter six) is an approach to meet these moments. Further it illustrates how touch can be applied as a genuine artistic medium through haptic storytelling.

5.6. COMPUTER-MEDIATED ART AND PHENOMENOLOGY

The phenomenological perspective brings the body back to art and aesthetics. As a field, art and aesthetics needs to be corporeally experienced to be understood. The questions to phenomenological art as proposed here, i.e. art that allows and encourages individual experiences, are (at least) threefold:

Firstly, what does phenomenology mean for art as an experience? Secondly, how does art influence our phenomenological understanding of the world? Thirdly, as the artistic core of this thesis revolves around touch in interactive art, how can interactive media art installations contribute to our understanding of phenomenology?

Looking at the last question first, several critiques can be raised against the attempt in computer-mediated expressions to see art through the phenomenological looking glass. One is if interactive media art installations really represent inventions and innovations for individual experiences as embodied being? How does an artifact produce a phenomenological experience of touch, texture, weight, gravity etc. of one's own body?

One critical remark here is that the combination of art and technology is not novel (Zielinski, 2006), but perhaps appears as the emperor's new clothes. More often than not we are being seduced by the appearance of slick high-tech apparatus, rather than its existential content (Reck, 2002:37). Others may reduce bodily experiences to a question of better or worse ergonomics. Reflecting on the techno-utopian beliefs expressed in the film '*Lawnmower Man*' (Brett Leonard, 1992), one could even ask if the trust in virtual reality perhaps is a question of speculative metaphysics relating to an apostasy of virtual - technological beliefs, leaving others 'prey to reality' (Baudrillard, 1990:14). Meeting such questions and challenges is rather difficult, since touch and computer-mediated art is a field of study which is comparatively young and with few references. This research hopes to give some indications to the field by analyzing the inclusion and addition of haptic, multisensory interfaces as new tools for perception in the perceptual arena. Here the media arts' advantage is to provide an open field for phenomenological 'trial and errors'. In my projects, touch is undeniably there in both 'real' or 'virtual' encounters. Even if it is done crudely and

mechanically it is present and not just an illusion. This is of deep phenomenological significance.

Returning to the first question, phenomenology explains how we encounter the world and act through it. A transparent art installation that embodies the user in sensual experience is –in Heidegger’s term– ‘*ready-to-hand*’ (*zuhanden*) for the user (Dourish, 2004:109). Inclusive touch includes the body and (ideally) becomes functionally transparent in promotion of the artistic experience. Taken the example of a non-transparent, non-functional touch system this would be ‘*present-at-hand*’ (*vorhanden*), that is an object of my attention. This focus on obstructive objects affects the experiential quality of the artistic work. As discussed in chapter three on psychophysics, installations can influence a ‘sensory-reset’ if they appear so different that they cancel the user’s expectations of what can and will happen. In this context a phenomenological approach becomes a useful tool to *analyze and possibly design better interactive art*. Some aspects to elucidate the second question of how art influences our phenomenological understanding of the world, will be exemplified through the Erotogod experiment in chapter six, where the intention of the art work was to promote an intensified experience of an embodied environment.

5.6.1. Intensity and breakdown

How does one create an intense experience for the user of haptic installations? This implies the question of breakdown. In the case when an ontic, that is particular experience of art falls apart, the art installation goes from being ‘ready-to-hand’ to being ‘present-at-hand’. We have a breakdown experience that triggers reflection. The Erotogod experiment has the epistemological intention to observe and describe how these glitches (collapses) of experiences reveal more of the nature and significance of the use of vibrotactile touch. What happens for instance if the transparency of the everydayness is broken? Observations of user could then perhaps reveal abnormal behaviour, such as users of interactive media art installations slowing down, stopping to look at that-which-is-at-hand. If this can be observed and reported then it could hint at the occurrence of a perceptual breakdown. This and its implications ought to be deductible through the questionnaires as well as through observation described in chapters six and seven. There are many critical factors in such an approach. What if users have neither the interest, nor the intention to use the technology? Then what appears as breakdown can just as well be the expression of uninterest.

Within a phenomenological context the multimodal, immersive experiences like the Erotogod installation, add ontic emphasis to our being-in-the-world. Further, the interactive dimension of works focuses on how embodied experiences that—in line with Merleau-Ponty—can be seen as an

open, continuous and contingent process with an inner sensory dialectics. This sensory dialectics is defined by the fluctuation between functionality (as transparent experience) and dysfunctionality, as in a Heideggerian breakdown situation. Again, it is through breakdowns that, in Heidegger's terms, the world reveals itself to the *Dasein*.

In an epistemological context experimental installations that challenge the transparency of our being-in-the-world, open up artworks and art experience as topics of research and thereby contribute to the generation of new knowledge in the artistic field. Using touch as both an expression and material can contribute to perceptual 'break down' scenarios that are important in revealing *something-as-something*. The next paragraph will look closer to the corpo-material conditions for this.

5.7. PHENOMENOLOGICAL MATERIALISM

First let us go back to Heidegger and his use of *Dasein*. It is often interpreted ontologically as meaning existence, but it can also be understood as *Da-sein*, that is *Here-being*. It implies *being-there* as essential for any phenomenological experience. This being-there is dependent on the body being present-at-hand in the causal events that make up the world we perceive. This is what Ihde calls an *existentialization of experience*. You really have to be there, to occupy a certain place-time to experience a world or situation (Ihde 1991:49). Your body becomes the *material condition* for perception. This marks the emergence of '*phenomenological materialism*' according to Ihde. In as far as the body is a part of this, M.P. can also be considered a materialist. Problematic in the use of the notion of materialism is its close relation to Descartes's dualist world view—which is what Merleau-Ponty's notion of embodiment tried to reconcile by putting the body at the centre.

In his book *What Computers still Can't Do* Dreyfus opened with the notion of instrumental embodiment (Dreyfus, 1992:235). In line with Merleau-Ponty, he argues that in order to think, one must have—or be—a body. Dreyfus shows this negatively by demonstrating the consequences of lacking a body. As computers do not have human bodies they can also not think as humans. In order to think one must have a body. The body is both in the world and that which gives access to things in the world (Watkin, 2009:20). As Dreyfus further notes '*thinkers (---) which from Plato to Descartes has thought of the body as getting in the way of intelligence and reason, rather than being in any way indispensable for it*' (In Ihde 1991:69). What happened in the North American development of earlier European phenomenology was the onset of what Ihde calls the 'body philosophers' (Ihde, 1991:68). Technology entered into the equation. In the form of instrumentation it 'closes the gap between the Lifeworld and the world of

science'. Science can here be understood as embodiment in instrumentation. Of interest here is the interpretation of the *Da-sein* as instrumental embodiment. One of the unanswered questions is how the body affords – in the sense of opening up to, facilitating for – the world. To answer this it can be useful to invert the question and look at how things afford the body. This is particularly relevant for the design of haptic user interfaces and ergonomics.

5.8. CORPOREAL AFFORDANCE

How does the body contribute to an understanding, or even construction of meaning? As signposted in chapter one, Merleau-Ponty calls the complex, interrelated chain of factors that constitute our lives for the ‘‘intentional arc’’. Hubert and Stuart Dreyfus explicate Merleau-Ponty’s theories by pointing to the ‘three ways our bodies determine what shows up in the world’ (Watkin, 2009:21). If we take the basic structure of the body as something given, then one can argue for a ‘facticity of the perceptual world based on corporeality’. This is an interesting aspect relating to the analyses and understanding of the way haptic stimuli are applied and perceived in my projects. Dreyfus and Dreyfus argue that the three ways things show up in the world are i) biological: the body’s innate structures, that is a given body and its given biological constitution, ii) historical: general acquired skills and iii) cultural: specific cultural skills, that is skills acquired through training. The example given is how a chair affords sitting, that is how an object affords¹⁰⁵ the body:

Because we have the sort of bodies that get tired and that bend backwards at the knees, chairs can show up to us – but not for flamingos, say- as sitting (*innate*). But chairs can only solicit sitting once we have learned to sit (*acquired*). Finally, only because we Western Europeans are brought up in a culture where one sits on chairs, do chairs solicit us to sit on them (*cultural*). Chairs would not solicit sitting in traditional Japan.’
- Dreyfus and Dreyfus, 1999:104.

This way of structuring Merleau-Ponty’s embodied philosophy within three analytical observation points makes it easier to understand phenomenological problems. By bridging the historicism/ biologism dilemma (Watkin, 2009:21) it also contributes to understanding the complexity of perception. Don Ihde takes part in this discussion. His understanding of perception is close to Merleau-Ponty’s in the sense that sensory, or bodily, perception is always understood to be situated within a kind of cultural perception (Ihde, 1991:12),

¹⁰⁵ Affordance is here used in the sense of *facilitating for*.

but Ihde expands this, adding emphasis to contextual perception. We experience the world through our biological given body. How we interpret our experience is influenced by the cultural, historical and contextual framing of the same experience. An example is the vibrations of contemporary mobile phones. This haptic signal is usually conceived as a neutral sign of an incoming message. In everyday activity such vibro-tactile stimuli are used to perceive call reception (Yim, Myung & Lee in Aykin, 2007:646). However, in a different ‘affordance situation’ with different biological, historical, cultural and contextual discourses, it could also be interpreted as a personal and sensual touch by another human. In my projects I use the cultural context to influence the ‘affordance situation’ to change the common perception of vibrotactile touch as we are currently accustomed to it, for example, through mobile phones. The combined psychophysical coding and the multimodal stimuli contextualize the vibrotactile output in such a way that the previous understandings of vibrotactile stimulation break down. The stimuli must be reflected upon which in turn form new meanings. This is an indication of how our perception of experience can shift when our phenomenological understanding of *something-as-something* also shifts. Multiple conditions and discourses must therefore be taken into consideration when explaining how things account for corporeal affordance.

One issue that is missing is the relation between biological and cultural context to the social. A critical remark to Dreyfus is how embodiment and situatedness facilitates the understanding of social facts. With reference to Heidegger, Kohji (Kohji, 2007:222) argues that by emphasizing the non-representational character of embodiment one can fail to appreciate the importance of reciprocal recognition and interaction in sociality. Since my projects deal with single users perception systems this is not directly relevant for our discussion of touch here, but brings in moments of interests for future interactive and intersubjective systems involving more users.

A second question of interest is the relation between tacit knowledge and corporeal language. ‘*When we learn to use language, or a probe, or a tool, and thus make ourselves aware of these things as we are of our body, we interiorize these things and make ourselves dwell in them*’ (Polanyi in Little, 2005:114). In Husserlian terms Polanyi describes here how internalization makes the body become one with the noema. How do we express the knowledge acquired? Levin (1985:244) calls the order of the body the ‘*immanent logos of the flesh*’ (Watkin, 2009:21). Does this *logos* possibly indicate a tacit expression of a haptic language? The explication of this is of high interest to definitions of artistic research (chapter two), but will not be further discussed here. A third issue worth mentioning, but not discussed further here, is Gibson’s ‘ecological psychology’, an analytical stance

towards the intentionality of individual's actions, emphasizing the reciprocity of the environment and the person (Heft, 2001:8).

The three dimensions of how corporeality contributes to an understanding of meaning have a direct influence on how this research can be evaluated. As outlined by Dreyfus & Dreyfus this thinking represents tools well suited for the analytical toolbox when analyzing touch and the use of haptics. A concrete approach derived from this are the questions:

- To which degree relate condition, affordance and cultural understanding to each other in Erotogod?
- What could be changed in the future by i) user comments, ii) technical feedback, iii) issues related to culture?
- What is impossible to change (bodily configuration, affordance and cultural background)?

Habermas furthermore describes our Lifeworld as having three dimensions: culture (objective dimension including facts, etc), society (social dimension including norms, etc) and personal (subjective dimension of personal taste, feelings, etc) (Ritzer, 2005:351). This also represents an interesting categorization for analyzing how touch is perceived, but as his approach is more directed at social theory this thesis will focus on the Dreyfus & Dreyfus' individualistic and existential approach to meanings of touch.

5.9. SUMMARY AND DISCUSSION

This chapter has presented theoretical frameworks behind embodied experiences ranging from Cartesian dualism, alternative models of perception like Uexküll's subject-oriented biology and Skramlik's concept of haptic space to the phenomenological view. Embodiment is investigated in the context of the interactive art experience. The main focus of the chapter is on phenomenological approaches to perception and touch. Phenomenology is discussed through its early development with Brentano onward to Merleau-Ponty's theories on embodiment. In phenomenology intentionality is a form of being-in-the-world, and the field as such emphasizes the importance of embodied action for shaping perceptions and forming meanings. This approach is particularly suitable to describe haptic media-art experiences.

A core issue introduced here in the relation between altered experience and embodied consciousness is the notion of a 'break-down' experience. In such situations, as the famous hammer example by Heidegger shows, an object –or situation- goes from being engaged, active and ready-at-hand to becoming broken down, disengaged and present-at-hand.

The breakdown scenario of the hammer can be used to analyse installations like Erotogod in the next chapter. The ontic materiality, that is

the flesh (Sartre, 1996:430), reveals the *Dasein* as the *natural attitude* of ‘*being there*’ every time the slightest thing, equipment or cable break down. Related to Penfield’s Bodymaps (section 3.3.3) it was questioned if lower sensory areas like the legs and back need less direct physical stimulation than high sensory areas like the lips. Induced breakdown in the form of removing –or failing- back or leg stimulation from patterns where they are usually contained, could prove a relevant test of this. The Tau effect foresees here a breakdown of haptic expression (moving pattern), but this remains to be tested. Findings can prove significant for the construction of haptic stimuli and bodysuits as it could influence both the numbers and placement of effectors.

A similarity between the breakdown scenarios in Heidegger, Vygotsky and activity theory is that they trigger reflections in the individual. Breakdowns observed in the context of haptic immersion in immersive environments therefore possibly imply a phase of embodied creative reflection. This provides a hermeneutic approach to phenomenology and the question of how to interpret embodied experience. Here is a list of other issues related to breakdown situations:

- A chain of events cause a chain of break down situations. These situations trigger reflection and new thinking resulting in new knowledge, approaches, and situations. Combinations of multimodal technologies - and including touch in particular- is a highly fruitful approach/environment to trigger a chain of breakdowns.
- Interactive media art installations contribute to our understanding of phenomenology through the staging of perceptual breakdowns.
- Our embodiedness affords reflective breakdown (Vygotsky).
- Breakdown is a small crisis of embodiedness/perception that stimulates reflection and thinking. It is a provocative situation that challenges the user, leading to evocative reflection.
- Related to the ‘reset’ phase approach used in psychophysical approaches, the psychophysical and phenomenological techniques of perceptual manipulation and consequent reflection come here together to form a tool for creating breakdown situations that lead to meaningful reflections and new knowledge
- There is no conclusive phase of breakdowns. Rather it is a continuing chain of events interrelated to a living practice. It is an element of the intentional arc (MP), dependant on the various affordances (Dreyfus & Dreyfus) and a continuous repetition, cyclic behaviour to the end of life(cycle). Its intensity relates to frequency.
- Touch is part of the phenomenological concept focusing on the living experience with all the directedness of a living body. This

exemplifies Husserl's phenomenological turn: to explain the gap in consciousness how intentional objects can have a shadowy existence separate from reality one must look to lived experience.

- It is breakdown situations that bring our experiences to view. This is at heart of Merleau-Ponty suggestion to 'suspend for a moment our recognition of them (our experiences)'.

The phenomenological approaches in this chapter present possible tools for analysing users' reactions and understanding the reactions to touch in multisensory environments. As discussed, many issues affect the users of my installations, and evaluations of breakdown situations must therefore also take the complexity of embodied reality: the *intentional arc*, social systems, cooperative issues and individual differences into consideration. Merleau-Ponty indicates how the body has a natural inclination to tell stories (section 5.5.). These spontaneous stories indicate how touch can become an artistic medium of its own through *haptic storytelling*.

There is no easy answer to how touch affects us, but as Dreyfus notes on the relationship between thinking and computing, we cannot think unless we have a body. This is the phenomenological materialism where the body itself is the material condition for perception. As this thesis is about the corporeality of the experience of touch, touching the body implies touching perception.

Dreyfus & Dreyfus' tools are particularly useful to analyze touch and haptics through questioning i) the various degree condition, affordance and cultural understanding relates to each other in Erotogod, ii) how changes can happen through feedback from user, technology and cultural conditions, and iii) trying to reveal invariable constants in the environment.

A phenomenology of touch as it appears here, allow us to understand the interplay between subjective, felt embodiment and the psychophysically contextualized work of art. The transformation of theoretical tools, approaches and understandings into functional tools is what the next chapters will attempt.

6. PH.D. EXPERIMENT: EROTOGOD

As words are printed on paper, EROTOGOD prints new words
as sensations on the body.¹⁰⁶



Figure 6-1 Image used in the original Erotogod project proposal mixing different biological, technological with religious references.

The following chapter explains and analyses the multisensory nature of the Erotogod experience, how tactility was engendered and engineered through a mixture of technologies and approaches. The chapter will further describe the multisensory aspect of interfaces as they have evolved through the project. Also it will continue the discussion started in chapter four on how engineering problems were overcome to enhance tactility. Further it will discuss tactile technologies in relation to creating the different feelings of touch, and what is involved in the multisensory engineering of the experience of tactility for the participant. The issue of how to employ and use tactile stimulation will be described from the perspective of a practicing artist. The observations, research questions and hypotheses as described in chapter one will also be discussed here. The first half of the chapter will focus on the general look and feel of the installation, the second half will present and discuss the haptic technology used. In the case of haptic storytelling, touch presents itself as a genuine artistic medium.

¹⁰⁶ Text from the original project description, 2000.

6.1. AN ARTISTIC EXPERIMENT

At the foundation of this thesis lies my artistic work and experiments with touch. In the following I approach touch as an embodied experience.

Questions of relevance concern how touch appears and how it affects the experience of art.

My first works with virtual environments and touch dates back to cyberSM (1993) that corporeally connects two users on the internet (section 4.8). It marked the beginning of overcoming practical and engineering limitations to build tactile bodysuits that enhance the sense of immersion within detailed and dynamic virtual worlds. The main project that this thesis is built upon is my work with the immersive media art installation the Erotogod experiment (2001).¹⁰⁷ Here a key aspect to sense interaction and immersion for the participant was the use of an ‘intelligent’, two way tactile bodysuit. The project creates a sensory loop between the one user (at a time) and the installation. By autoerotically touching their own body, users would type textual expressions. These words and sentences would in turn express themselves as i) 3dimensional sounds and graphics inside the installation and ii) touch on the user’s body.

The background of the Erotogod project is first and foremost as an artistic project. It can however be seen as two independent projects, one artistic and the other scientific and research-based. The common ground of the two approaches is the aspiration of acquiring new knowledge through art. My personal ambition has all the time been to utilize the scientific endeavour and inquiries to make better art projects. A central epistemological question posed by the Erotogod project is what kind of knowledge is being built by this type of research? This refers back to the chapter on methodology and the question on how the artistic and the research-based projects both differ and influence each other (Smart, Walters and Elshaw, 2007). One of my intentions with Erotogod was to research and develop our epistemological sense of reality. This refers to how we sense *something as something*, and in which ways we for instance can experience haptic telepresence (cyberSM) as real.

6.2. PROJECT SET UP

The project was set up in two parts, one artistic and one research-based. The artistic part of the ‘Erotogod’ experiment was an experimental, immersive and multisensory media-art installation that attempted to probe further into the possibilities of haptic technologies. As in my previous projects cyberSM and Solve et Coagula, it artistically elaborated on the sensual dimension of aesthetics by connecting advanced computer and interactive technologies to

¹⁰⁷ Erotogod was realized together with Knut Mork, Trond Lossius and Asbjørn Flø.

the body as a sensual interface. Erotogod was shown for the first time in autumn 2001. It was presented as an opening installation for the Ultima festival¹⁰⁸ for contemporary music at the Henie Onsted Museum -and installed there in the Studio Room- from the 6th to the 22nd of October 2001.

The artistic context of presentation underlined the artistic over the scientific dimension of the piece. The context further influenced the users of the installation. Here a critical factor is that the artistic history of the Henie Onstad Art Centre that makes many visitors perceive everything exhibited as obvious pieces of art. They are, in other words, conditioned to understand the works in a specific cultural and historical perspective. To register and investigate the contextually coloured perception the need for hybrid methods (chapter two) are further underscored. In the project pamphlet distributed during the exhibition the work was described as:

an immersive sound-, text and sensory-installation. It lets the user conceive his own personal and sensual story of creation. The content is made dynamically by the transformation of religious creational myths by the (autoerotic) corporeal stimuli and expressions. The user of the installation is situated within a real-time generated audio-visual space defined by a three dimensional projection of (evolving) text and a three-dimensional auditiv composition (16 channels). Dressed in an intelligent bodysuit the user can touch and feel the intelligent 'emotional machine'.

A second and modified version was presented at the Dutch Electronic Art Festival (DEAF) in 2003. This version was shown a third time at Atelier Nord in Oslo late 2003. The art installation is a result of my previous and informal practice-based research. It is a multisensory space of experience that lets the users interactively write their own myths of creation by autoerotically using their own body as interface. As in my other experiments the installations immersive environment is based on the technologies of real-time generation of graphics, sound and haptics in combination with a physical installation/environment that mentally 'codes' the user's expectations as well as behaviour (see chapter three on psychophysics).

The second part of the project was the formalized, research-based component, which took shape during the first years of the AHO doctoral programme. Beforehand specific qualitative research methodology was developed to ensure that I could extract the right kind of data to evaluate and appraise the project. The research was divided into several parts. The

¹⁰⁸ Homepage at www.ultima.no

interviews were done during the DEAF festival in Rotterdam 2003 to ensure qualified opinions from people with a specific interest in and knowledge from the field of art and technology. Additionally a participatory user observation documented through field notes and video took place.

6.2.1. Artistic inspirations

In the original project description from 2003, Erotogod is described as

- A wearable, multisensorial space of experience
- A synaesthetic, autoerotic communication system
- A space for creative research on sensual experience
- A translator of corporeal experience into dynamic compositions of multisensory-text – and back

Further the project description says:

EROTOGOD is a multisensory space of experience that lets the user interactively write their own myths of creation. These myths appear as three dimensional sound, graphics and corporeal experiences. Together these expressions make a synaesthetic experience, that is, the combinations of multiple sensual modalities create a larger impression.

One question to be investigated in a research is how such ‘larger impressions’ are made and experienced. In order to meet this question, the project started with experimentations on synaesthesia.

6.2.2. A synaesthetic and multisensory experience

One of the open aims of employing multiple sensory channels into the Erotogod projects was to explore what happens to experience when the senses play together in unknown and new ways. The project is therefore also an experiment with synaesthetic spaces of experience. Synaesthesia is a term stemming from *syn* –joined- and *aesthesia* –sense-, i.e. cross-modal sense association (Cytowic, 2003), or the joining of sensations (van Campen, 2008). The synaesthetic effect can arise from the combination of a wide range of means and effects. The synaesthetic combination results in sense experience that is experienced as more than, or different from, the sum of the individual components. It is often described as a neurological phenomenon, but the question is whether it also can be provoked, or triggered, through cross sensory linking like sound-to-vision and touch-to-hearing. An artistic example of combining touch with hearing is the *e-skin* project by Jill Scott (Hauser, 2008:63). Through combining various wearable interfaces that can

both respond and produce touch as well as sound, the *e-skin* project attempts to augment the ‘*unique cross-modal potentials of human sensory perception*’. In Erotogod the synergetic linking of stimuli aims at facilitating an action-oriented, multisensory environment that promotes synaesthetic experience. The installation was multisensory in its combination of image and sound together with the two-way bodysuit. By touching his body the user uploads a ‘sensitive’ imprint of his body into the machine. In addition to influencing the sound and corporeal sensation, the installation used these raw, sensory data to output a 3D real-time, open-GL-based rendering of a graphical, text-based universe. It was seen on the three screens surrounding the user. The purpose of such amalgamation of different media and technologies is to increase the perceptual manipulation of the participants. The aim of this is to achieve a higher degree of persuasive experience. In the installation, synaesthetic input and output is employed as a method in the attempt to enable highly different experiences.

The synaesthetic is also about experiencing unexpected results. The participant in Erotogod is not just passively having a sensual experience. Artistically the installation aims at making the user into a writer of new, synaesthetic text and a composer of new, personal and individual experience. Synaesthetic text refers to the phenomenological experience of meaning that is experienced through what can be termed *multimodal semantics*. Multimodal semantics means here: information received through several channels of sensory stimulation that attempt to communicate the same (textual) message/information/content. In Erotogod the users’ autoerotic touch is interpreted by the installation and translated into multimodal expressions through letters and words, graphics, sound and (re)touch through the suit. Likewise, when the user is not active, the synaesthetic text of the installation translates the textual output (expressivity of the installation) into sound, visuals and touch. This explains why the installation attempts to print words as sensations on the body like words are printed on paper.

6.2.3. Art, corpus and religion

The coupling of art, body and religion in Erotogod needs further explanation. The main reason for this coupling is of artistic nature. Having grown up in a Christian culture, I have always been exposed –and puzzled– by the strong belief in the word based interpretation of biblical texts. Christianity appears founded on an intellectual exegesis. Today, the reference to textual truths appears outdated in a culture that has gone from an agriculture-based economy to an experience-based economy (tourism, services, entertainment and leisure) within a few generations (Pine and Gilmore, 1998). As a consequence of this development, experience, really being there, matters today as much as the description of this occurrence.

Moreover, writing texts like emails, sms, blogs etc. today it is not just about informing about standing points or opinions but the online writing is an experience in itself, a meeting and interfacing with the world.

For these reasons, text writing has become a tool to promote and experience reality. To paraphrase Ballard: we live inside an enormous novel, and the task now is to write reality (Ballard, 1995: introduction). Edgar Dale's 'Cone of Experience' positions verbal experience at the other end of the scale of direct, purposeful experience (Dale, 1969). Inspired by the opening line of the Bible, '*In the beginning was the Word, and the Word was with God, and the Word was God,*' it became an artistic intention to investigate how the two dimensions of verbal versus embodied experience correlate through interactive technology. How is it possible to print words as experience on the body? And translate embodied experience back into words? As the original text states:

The installation comments on the transformation of our changing religious experience—and writes new stories about God based on body, sound and text. It elaborates on the sensual dimension of aesthetics by pitching advanced data- and interactive technologies against the human body as an emotional surface.

The religious focus in Erotogod was inspired by the enormous attention on the Millennium change in 1999. The Millennium eve of December 31st 1999 was the hot topic for the planning of an enormous global party in a world that—at the time—was ruled by the dot.com hype and economic boom. At the same time it also triggered speculation of catastrophic events like the Y2K millennium bug (Cole, 2007:227). An early, incomplete way of writing dates in computer programs caused widespread concern that critical sectors such as electricity, finance and government would cease to function at the stroke of midnight between December 31, 1999 and January 1, 2000. Needless to say it did not happen, but the dystopic expectations that started a long time before New Year's Eve were spectacular and on the brink of being hysterical.

Another phenomenon that inspired Erotogod was the fact that the main monotheistic world religions have central concepts of the Millennium change in combination with the end-of-time and the Apocalypse. These religions are based on the concept of revolution, like the coming of the prophet or rebirth of Christ. Symbolically therefore, it became one of the artistic goals not just to let the new @volution happen, but also to write the new 'holy' text of creation based on the sensual combination of man with computer-based technology. The text therefore also said:

Through the installations tactilisation of the digitally real we see the contours of the future Emotional-society that we are heading for. The computer of the future is the one that will have a real physical impact on our environment. The coming digital society will therefore be focused on experience and sensations. The sensual – that is the tactile – will be a new economy. Erotogod writes its new bible.

The biblical allegory is here meant as a challenge to our immaterial and mono-sensory reading of words and text. Furthermore it underlines the transition to the experience economy that we arguably already have undergone.

6.2.4. Psychophysical coding of Erotogod

One reason for writing such manifesto-like texts as the first Erotogod project description is to psychologically induce a setting and expectations in the user. Text is one way of contextually influencing the user's perception and belongs to the general psychophysical environmental design as discussed in chapter two.

The psychophysical coding starts a long time before entering an installation like Erotogod. It starts with inducing expectations in the user. Usually exhibitions are marketed under some kind of theme. Under DEAF 2003 the theme was 'Information is Alive'. In the context of an electronic art exhibition many users also have a special interest in the topic and inform themselves through the web and news channels. A direct consequence of this mental impression or 'coding' by telling that something is 'alive' in the context of interactive art is that visitors expect to feel, sense, experience something like a virtual zoo with 'living' experiences'. Experiences about being 'alive' will most likely be perceived highly individually, but the buzzword 'alive' emits the impression of something related to the body. When visitors/users enter the exhibition space other elements start to influence them. Sound and visuals are obvious elements attracting or repelling the audience. Others are smells, stories being told by guides and artists, the size of the crowd waiting outside of the installation, light, shape of the installation etc. In Erotogod all these elements became a part of the installation.

The *psychological* coding of Erotogod inside the exhibition environment in Rotterdam started with of the elements all visitors could perceive from the outside, *before* trying it physically. These elements were text, installation design, sound, light and visuals. The installations appearance was designed to both function in order to immerse the user in a 16 channel sound sphere and to represent a *rite of passage* giving the impression of being led into another

‘world’. Elevating the user platform to 1,5 meters above the floor enabled both to place subwoofers and loudspeakers beneath the platform, thus enabling physical sound impression from below, and symbolically leading the user *up* into another place. This was a designed solution chosen out of aesthetical reasons since, for example, simulating sound through binaural rendering head in headphones could have given a much cheaper and simple solution. An additional element on the platform was the inscription of symbolic and hardly readable text carved out of the sides of the platform. At the Henie Onstad Art Centre the platform was lighted with special light diodes. Again this was done both to practically present the stairway up to the platform as well as emphasizing its dramatic looks. The sound heard around the installation was similar to the inside minus the three dimensional effect. This was done both to communicate the content to the many visitors that could not try it and to attract users’ attention. The same was for the visuals. It was also designed to make the installation function both as a sculpture and immersive environment. The perception of the visual from the outside gave an impression of the inside, but could not convey the immersiveness experienced on the inside.

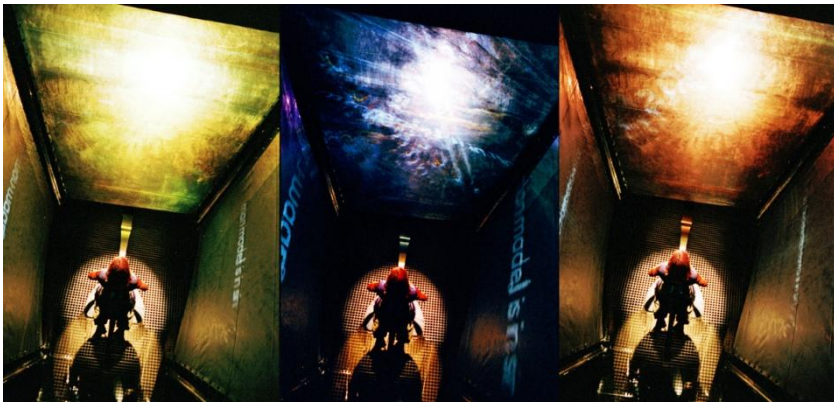


Figure 6-2 Top view of the installation showing a user immersed in the projection space showing a range of light and colours seen.

The *physiological* coding of Erotogod consisted to a large degree of the same elements, but with a different approach and effect. Visually the user is placed in such a position with head and body that the three projections completely fill his/her visual field, thereby evoking a physical impression of visual immersion. By using custom built transparent screens we could also project from the outside, thereby placing the screens very close to the user and thus filling the field of vision even more. The positioning of the user’s head to be in the middle of the 16 channel audio sphere is done to physically immerse

the user in sound. Again this was chosen out of concern for the physical effect as a projection on a wall and sound heard through headphones would have given similar, but much less corporeal effect.

The main physical element of impression was the vibrotactile patterns felt in the suit and will be discussed more in detail in the next sections. The autoerotic (self touch) design was done to complete the user's sensation of immersion. You had to act on your own body, making it into an object of interaction. This choice of design can perhaps better be understood in relation to another alternative: an implementation of feedback buttons equal in size and number to a keyboard like panel in front of the users could have given a more precise control and influence on the installation, but at the cost of less mental and physical inclusion/immersion.

This separation of the psychological and physiological elements presented here is artificial. As with the haptic and multisensory installations of cyberSM and SeC, the elements and impressions needed to create haptic experiences bleed over into each other, making new, hybrid combinations possible. An example is the effect of making the Erotogod users physically kneel down. Seeing and listening in a kneeling posture is different from standing. Erotogod positions the user both mentally and physically into a submissive figure against the oversized projections and –screens.



Figure 6-3 View of the installation towards the entrance. While not in use the projections would slowly rotate and pulse to catch the attention of the audience.

The installation represents a complicated psychophysical scenario by looking not just at what happens to our perception when the strength of stimuli is varied, but also how perception is changed and manipulated with different multimodal combinations. A complete control of all these elements was not possible within the practical limits of the project. The psychophysical coding of an installation does not need to end with the actual physical experience inside it, but can evolve with the stories revealed in the aftermath. Examples of this are the stories of touch told by users of the Telematic Dreaming installation (Classen 2005). Such *haptic visuality* reactions can be read as what Vivian Sobchack calls the volitional, deliberate vision (section 3.3.7).

On a conceptual level art projects can evolve into mythical stories like the ‘GFP Bunny’ or better known as Alba the Rabbit Project by Eduardo Kac (Kac, 2005:264). Alba, the genetically modified rabbit, was supposed to glow in the dark and was to be adopted into Kac’s home. However, Alba never existed. It was based on an idea of Kac’s and the possible production of such rabbits. It a classical hoax art and had an enormous success in terms of the attention it got in the public press. Another example of how ideas generate physical output through mental stimulation is the radio version of *The War of the Worlds* by Orson Wells (Wells, 2004:221). The radio broadcast in 1938 described an invasion from Mars and was perceived as so real by the listening audience that it caused mass panic in the U.S.

Critical issues relevant to the concept of psychophysical coding are several. One is the question whether experience really can be coded? And how does one influence conscious versus indirect, hidden emotions? This depends on how far experiences can be generalized and translated into repeatable ‘trigger’ functions. How can I be sure something is something – and not just purely mental? How not to fall in the Cartesian gap? Does the mental produce the physical reactions? Or the other way around? How big is the role of environmental stimuli really, and how does it influence our perception?

Also, according to Bourdieu¹⁰⁹, artworks are products of a reciprocal process of production and reception in history (section 3.4.1), how then can the cultural influence be properly measured? And what if the cultural influence and trends produce senses of touch? Examples of this are the many hyped stories around VR in the 1990s. Histories of VR replacing reality proved to be a kind of self-fulfilling but imaginary story without a foundation in physical reality (Ihde, 2002:xiii). This could be the case also for the experience of touch in my projects. One way to check this out is through the user perspectives and feedback. The response given and observed indicates

¹⁰⁹ This is also found in the thinking of Heidegger and Adorno.

that users felt both embodied and touched relative to the intentions of the installation. This will be further discussed in chapter seven.

6.3. THE INSTALLATION

The installation is built in a psychophysically manipulative manner. Technically the construction is optimised to gain the maximum effect out of sound and visions. When it comes to shape and design it is made to appear strangely attractive for the users. This reflects the issue of sensory reset as discussed in section 4.9.6.

One aim with this unfamiliar design is to make the participant question themselves what can happen inside it. It is also important to heighten the curiosity of the audience outside the installation. The goal with this strangeness is to achieve some kind of 'reset' phase of perception where the audience/user no longer knows what to expect. The user is therefore less prepared and potentially accepts any experience. This 'reset' phase to less or zero expectancy is important as a starting point of manipulative psychophysical coding. He or she has then metaphorically become a white sheet to draw new experiences on.

Upon entering the seven meter long and four and a half meter tall installation of metal, screens and light, the user is instructed to kneel down. She or he is then dressed in the bodysuit of the installation and given instruction for how to use it.



Figure 6-4 Side view of the installation at Henie Onstad Art Centre in 2001.

Making the user kneel down is not just a religious allusion, but of instrumental importance. When the user kneels down they have fixed their main perceptual axes. The user will then always be directed towards the main screen. The system would so at all times have a fairly accurate idea of where the user is looking and what the user perceives. This fixing of position enabled us to avoid the use a head or body tracker that we had initially planned. Even if trackers would have let us better analyze user position it was evaluated as marginally necessary compared to the overall holistic, sensual experience of the multisensory system.

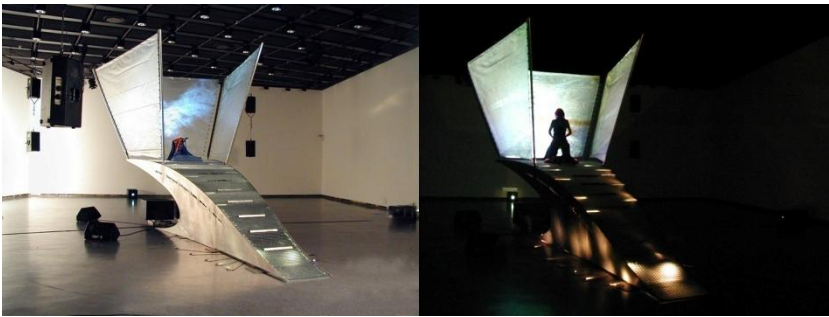


Figure 6-5 The same view of the installation in light (left image) and during function in the dark (right image).

6.3.1. Usability

From the usability and Human-Computer-Interface (HCI) point of view, one of the success criteria was for the users to dress in the system, engage with it, and create an intuitively interesting experience within the timeframe of a maximum of ten minutes. Short time spans are necessary for the installation to function as an exhibition piece within the context of an art exhibition. Even if short, it was deemed sufficient to observe the user's initial responses to multisensory experiences. My own observation of users that returned for a second or even third time revealed an increase in their qualitative impression of being immersed in the system. Ideally the time span for each user's tryout could therefore have been doubled, but it was not critical in the setting of the Erotogod experiment.

Ease of use reduces learning curves and drives user satisfaction (Jacko and Sears, 2003:781). Therefore it is a design issue that contributes to enhancing the user's experience of immersion and interactivity. To learn to use the installation each user was dressed in the bodysuit and instructed by an assistant. The assistant was present at all times, both to instruct, look after safety of the user as well as to protect the installation from critical situations.

To protect the equipment from users is important in the open user events where Erotogod was shown. There are several worst case scenarios that can happen, everything from various equipment breakdowns, software failure to unexpected user behaviour. Even if strapped in a suit and literally tied to the installation by cables, many users forget this and stand up or move away as if they were unrestrained. If they did, the risk of breaking cables was high. Cable breaking is one of the worst things that can happen to such an installation. Unless a cable is visually ripped apart it can be very hard to localize which of the installations more than 200 cables would be damaged. It is therefore time consuming repair and could as a worst case scenario lead to huge delays in exhibition time or even temporary closing down of the installation.

Why did some users forget they were strapped in a bodysuit? This could be an indication of their experience of system transparency and ease of use, but also of carelessness. The worst thing that happened was one user who panicked slightly and tried to walk away with the suit on. To avoid these situations every user was given clear, direct and personalized instructions on not leaving the installation until the assistant did so. The assistants were trained to use a personalized language establish a more personal relation to the users in the shortest time possible. Techniques that worked were both looking the users directly in the eyes and explaining the suit while putting it on the users, saying e.g.: *'this part of the suit will touch you here and there'*. In terms of talking to the user it was helpful to emphasize the use of sentences where *'I'* and *'you'* frequently was used, like *'I will now dress you'* and *'do not leave the installation until I come to undress you'*. To address safety the user was given clear instructions that he or she at any time could give a signal that they wanted to leave the installation. It would then be stopped immediately. To achieve this we had mounted a large start and stop button at the side of the installation. This could only be operated by the installation assistant.

Having a personal assistant giving the impression of safety, care, ease-of-use as well as effectively telling how to operate it, became all important moments that made the learning curve shorter. Even if the complexity of the installation is fairly high, we managed getting down to a fairly short time span per user. Without inflicting too much stress on the users, the installation could have four to five users per hour. That means one new user every 12 to 15 minutes.

Developing an understanding of a multisensory language is harder. What does the input and output mean - both, separately and together in combination? What does touching yourself *'there'* mean? And what effects does it produce? What is sensible – or not? Due to the short time span per user inside the installation we had to work didactically to solve this. To

improve the understanding of how the multisensory system functioned we developed a model of haptic ‘*environmental reflection*’. The best results appeared when the user first encountered the closure body/suit/environment with a one-to-one reflection. This is a consistent mapping of body part to sensation, that can be easily learnt, for example, when they press the upper right breast, they will hear sounds from the upper right part of the audio sphere. If they press their left leg, they would sense both sound and touch from the lower, left part of the installation. This one-to-one, body-to-system analogue functioned well as an introduction to the use of the system. The first minutes after the installation had started this one-to-one story telling was emphasized. Then the output and expressivity of the installation was programmed to gradually include other parameters that would affect the overall expression of the installation.

6.3.2. Dramaturgy

Important for the sense of ease of use is also how the users mentally access and experience the story told in the installation. There are no context free stories or experiences. Simply being in the context of an electronic art exhibition tunes the expectancy and behaviour of the audience. To better design the user experience we developed an interactive model of *what* the user could experience *where*.

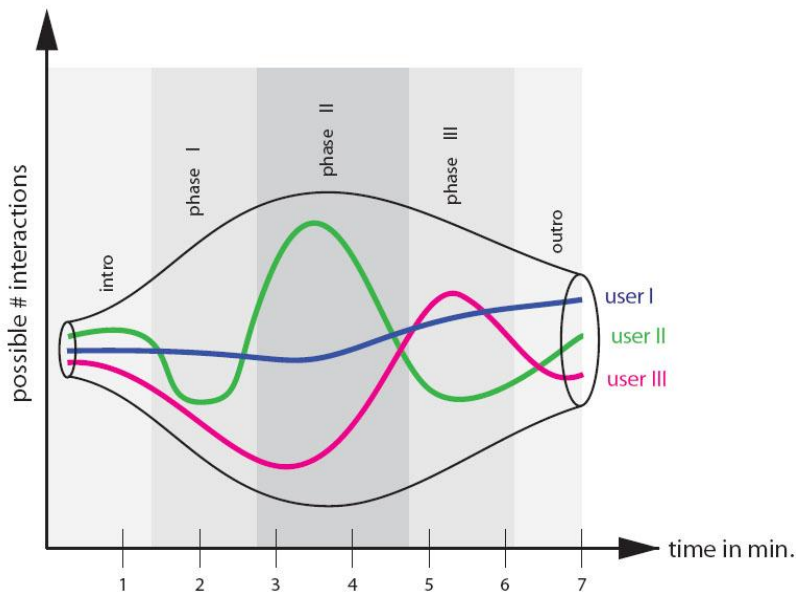


Figure 6-6 Illustration of the ‘Tunnel’ experience, 7 minutes long duration, the user is being ‘pulled’ through five stages/spaces of experiences. The user experiences relatively free interactivity and interaction within these constraints.

The user was met with the impression of an open and endlessly interactive experience, but in reality they moved within a limited space of data. The metaphor of travelling through a large tunnel-like space was developed to illustrate the user's interactive freedom and open space of experience.

6.4. HAPTIC TECHNOLOGIES IN EROTOGOD

The motivation to work with haptic technologies in Erotogod was to produce sense-manipulative art experiences that further investigate the way we perceive and understand the world. With immersive virtual environments and multisensory interfaces the artistic experience promises to become a sensual fusion of man and artwork, dependent upon the user's presence and bodily functions.

As mentioned, the Erotogod project is directly related to my other artistic touch projects, starting with the cyberSM project. Central to the cyberSM project was the use of stimulator suits which allowed the users to remotely stimulate one-another's bodies as well as one's own body. It was also a telepresence project. The main differences between the two projects is that Erotogod has i) a much higher sensory resolution for both input and output and ii) is a single user installation only. The possibilities of telepresence communication are not dealt with directly, but the Erotogod interface can be also seen as one of many communication 'stations' in a networked telepresence project. One goal with building a single user, high sensory resolution system was to further develop my designs for custom-made body-suits capable of creating various physical stimuli on the body of the wearer. Building on my experience from previous systems, there were many issues to be looked at. One critical element in the experimental design and evaluation is the problem of stimuli – response. How fast are the participants conditioned to the experienced touch? To what extent are the stimuli translated into action, if at all? Are the stimuli, due to the artistic abstraction, a language without meaning to the users? In how far is it a code that must be interpreted in their own way by each user? These are some of the challenges that can be tested and solved in the design of a bodysuit.

6.4.1. The bodysuit

This wearable bodysuit is a device in the shape of a suit that reads, feels and manipulates the users of the installation. It functions as auto-erotic, i.e. dependent upon the user touching themselves. With each self-touch the installation will know what the user does and react accordingly. Each user's unique touch-pattern creates individual expressions as well as impressions. These are not repeatable, and will be used by the installations software to render unique and unrepeatable experiences.

There are several critical moments with the design of a bodysuit such as stability, anatomical shape and the user's sense of transparency. Factors relevant for the aesthetic bodysuit design, wearability and the role of human form in wearable product designs are according to Gemperle et al. (1998) body ergonomics, perception, functionality, technology, materials, energy and possibly recyclability. Several of these issues were taken into account in the development of the Erotogod bodysuit. However, the main factors relevant for bodysuits in artistic context can be reduced to two: functionality and aesthetics.

One first challenge to be solved was to make a suit that fits all sizes and both sexes. Ideally we wanted to construct six suits in the sizes small, medium and large for both male and female. It was however practically impossible to build that many suits. Measuring various male and female bodysizes we developed an average anatomical model that we deemed would fit most users. To make the cloth stronger and keep the shape better we reinforced the suit by adding an inner kernel of plastic. This kernel was made through adding layers of duct tape to the body of a human. Adding a four to seven or more levels of tape made a fairly stable and lightweight body cast that could be further shaped through cutting and bending. This lightweight cast was then used as a fundament to mount the sensor and effectors. Around this fundament we then added the protective cloth. The advantage of this approach was the more stable triggering of the sensors since accidental squeezing was avoided. The disadvantage was the resulting thickness. My previous suits had all been very thin, usually made with double layered cloth resulting in approx 2 – 3 mm thickness. One disadvantage of this approach was that the suit felt more bulky and cast like. As the suit was mounted onto the motionless, kneeling user, the sensibility to bulkiness was reduced as compared to a moving users need for a more lightweight, anatomical transparent suit.

The bodysuit of the user is hardwired to the installation's special suit interface, a custom built interface with 128 analogue outputs, 96 digital- and 16 analogue inputs. It was run by a *Lua* (software) server that the project team wrote specifically for Erotogod. The high resolution of the interface enabled me for the first time to build a bodysuit with a high resolution for both input to the machine (sensors) and output onto the body (effectors). In effect the high sensory resolution of the suit turns the body into a sensory instrument. By touching one's own body the user could influence the overall state and expression of the installation as well as feel it directly on his/her own body.



Figure 6-7 The bodysuit seen in frontal view.

The Erotogod bodysuit incorporated all input and output into the suit itself. This ability to both sense and impress the user gave the suit a certain reactive ‘self awareness’ or ‘intelligence’ and in this sense it is therefore the first intelligent bodysuit I built. The bodysuit’s two-way functionality was achieved by building both sensors and effectors into it. Placing sensors directly on the body enabled us to directly read the corporeal state of the user. From the engineering point of view it presents a range of problems that had to be solved to make the suit function like a second, transparent skin of the user. Transparency is here used as an ergonomical measure of how the suit interferes with the user’s sense of interaction. A high degree of transparency indicates that the suit is not perceived as being in the way between the user and their own body. A low degree of transparency would reduce the autoerotic sensation of touching oneself. Some of the major problems with placing sensors on the body are involuntarily triggering by movement, squeezing, mechanical look-and-feel, discomfort and cable strain. I also needed to be able to fit them inside the suit to reduce the time-consuming process of placing them in the same position for each user. Exact placement is needed to gain a better understanding of the user’s situation as well as ensuring feedback to and control of the user experience.

Both the elaborate cabling and instrumental appearance of the suit contributed to the psychophysical design in order to prepare the user for ‘a different sensation’. One intention was to make the users feel as if they were ‘dressed in emotions’. Putting the suit on should not be like anything else or dressing in ordinary clothing. This was done through the use of special and expensive cloth carefully selected as to be comfortable to touch, the patterns sown as decorations onto the suit and the use of different cloth on the in- and outside. Also the weight of the suit, around one and a half kilo, was substantial enough for the user to ‘sense’ that something was going to happen. Another moment was the massive number of cables that attached the suit to the installation. The cables were fairly heavy, but by mounting the suit on a flexible yet strong metal rod, the weight was effectively supported by the same structure. As far as I am aware of it, no one ever complained about the weight or bulkiness of the suit or cables.



Figure 6-8 Inside of the body suit showing the square zones of the 'hot spots' (sensor + effector).



Figure 6-9 Female user dressed in the bodysuit.

6.4.2. Touch technology

How does one produce concrete and physically measurable sensations of touch? In my first experiments (cyberSM, SeC) I started out with an overall and open approach towards any kind of electromechanical device that would shake, move or vibrate the body. The first suit incorporated various haptic output devices such as heating pads, various vibrators, low-wattage

capacitors for delivering shocks etc. Based on ergonomical and functional issues such as power consumption, size, safety etc. the Erotogod suit only uses custom-made vibrotactile effectors. They have proved to be most effective, even if they are limited in their capability of producing a range of touches. For input I have found mechanically operated pressure sensors to function best. Some of the practical issues relevant for the implementation and use of input and output for touch technologies in art installations will be treated here.

6.4.3. Sensors and effectors

Sensors and effectors make up the two way input and output that make the bodysuit function. Sensors are basically any input device that reads and reacts to environmental changes. Effectors are any output device that influences the environment and/or user. They are also called 'tactors'. In the Erotogod experiment the environment is set to be the body of the participant. The construction of input and output devices to be placed on the body is quite challenging. Critical issues in the design and use of sensors are several. Usually sensors are placed on stable, hard and non moving surfaces. In body suits sensors must be placed on a moving and soft mass. Amongst the most common problems encountered are mechanical malfunction due to defects in material, short-circuiting because of humidity due to body sweat, overt physical tearing during dressing and undressing, cable tear and general mechanical wear down over time. Anatomical differences between users that makes it both hard to place and utilize sensors and effectors effectively, bulky clothing underneath the suit causing accidental triggering and lastly one could add hygienic factors. The sensors that can function inside bodysuits therefore need to satisfy certain specifications. They have to be fairly transparent in order not to get in the way of the users movements. Also they should not be triggered too easily or too hard, but only when the user willingly touches himself or herself. After having tested different types of commercially available sensors I custom built my own mechanical sensors. They were made of two thin sheets of conductive, metallic paper separated by a two millimetres thick and perforated foam sheet. These were positioned in a manner that made them relatively insensitive to accidental movement. At the same time they were anatomically flexible and adapted to body movement without accidental triggering. My experiences with the construction and use of this kind of sensors have proved them a fairly good choice. They are rugged enough to be placed on a moving body without triggering, yet precise enough to trigger when the user decisively pushes to signal 'I am touching myself'. The system would therefore know fairly well that a touch signal stemmed from an intentional action. Altogether ninety-six sensors were placed in a grid system inside the suit to cover the body.

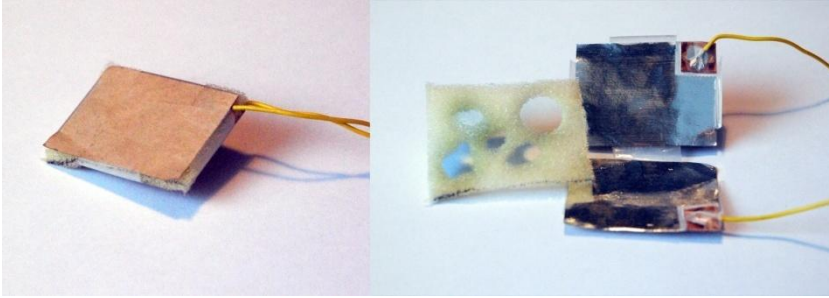


Figure 6-10 The Erotogod sensor construction. On the right one sensor (40 x 30 mm wide x 4 mm thick). On the left the inner construction showing the perforated foam keeping the two metal foils apart.

Problem solving is also critical during performance when time is short and users are waiting in lines. Examples of frequently encountered issues were sensors that triggered continuously, cable ripping and mechanical breakdown. None of these problems were particularly inconvenient. The main reason for this is the sturdy design that has been developed since the first cyberSM suit in 1993.

Underneath each sensor we placed one custom built, vibro-tactile effector based on my own design. These had a variable output ranging from ‘soft’ to ‘intense’. They were made strong enough to impress the user with the sensation of ‘touch’ even when she or he is wearing a layer of clothes underneath.

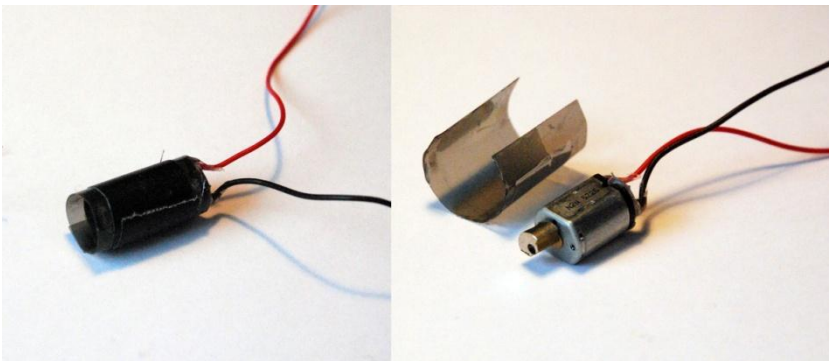


Figure 6-11 The Erotogod vibrator construction. On the left the finished vibrator measuring 26 x 12 mm. The right image shows inner construction with the motor (5V, 0.2 A), a disbalanced weight on motor shaft and outer protective layer.

My choice of vibrator was based on trial and error with other types of vibro-mechanical stimuli. Other types of vibrators I tried were adaptations of commercially available massage rods. These were opened, refitted and placed inside various suit designs. I also tried to buy vibrators, but these were both too bulky and expensive. I therefore ended up building my own, lightweight ones by adding uneven weights to the revolving axes of a small electric motor. For many of my experiments I have been using pager motors, small DC motors with an eccentric mass mounted on the shaft. Around the engine I put a thin, lightweight plastic. This was done both to protect the vibrator as well as making it as small as possible. Other commercial vibrators that I found all came with a housing too thick for my goals of a transparent, ergonomic suit design.

Combining input with output made the suit into a two-way interface to the installation. Such combinatory 'hot spots' of sensor and effector make it easier to map the body and allow for direct feedback. If the user pressed a button the vibrator underneath would give immediate feedback. This made learning and sensing the autoerotic functionality of the suit more intuitive. Additional effectors were placed on around the body, allowing the installation to 'draw' continuous patterns of touch, and to haptically immerse the user. How can this, for example, reproduce 'normal' touch like between humans? Comparing the sensory resolution of a hundred sensors and vibrators with the millions of various receptors of the body is an unequal match. Reproducing for instance light strokes on small areas of the skin is therefore generally out of range with the size and resolution of the Erotogod bodysuit. However, practically speaking the hundred and ten employed effectors cover the body fairly well and turns it into a sensual canvas for rather advanced haptic writing. Here a relevant question is how much of the body is needed to be covered by haptic stimuli in order to sense full haptic immersion? Which areas of the body are more important than others to cover. And why? This relates to the construction and functionality of effectors.

Each effector measured approximately one by two centimetres in size, but sensorially speaking it covers an area of at least five by five centimetres. The force is exerted by each vibrator is $(0.2 \text{ amp} \times 5\text{V}) = 1 \text{ watt}$. With such 'areal' strength of each effector I could have implemented up to two hundred to cover the whole body (see also section 4.9.2), but for the basic range of sensory sensations it would not matter much qualitatively. It is much more critical if the number of effectors is decreased. Based on my experiments with the '*sense:less*' system (Leopoldseder and Schöpf, 1996) I found that below thirty it is hard to induce impressions of full body sensory immersion



Figure 6-12 Showing the density of the effectors on one of the leg pads. Effectors are being mounted on top of the sensors (here bundled into what is seen as five stripes), facing inwards to the body.

As the user kneels down we did not cover the body below the knees. This made it possible to better bundle the sensor- and effector-zones. The final suit had four larger areas where I put the sensory ‘hot spots’ of the input and output zones in a grid-like composition next to each other. These areas, the chest, groin/waist and the two thighs had the highest density of sensors-effectors and accordingly the highest sensory resolution. The back was left partially open, but had four effectors reaching down to the shoulder blades. It is my experience that the back has less need for stimulation in order to ‘sense’ action. This is in line with the findings and body maps of Wilder Penfield (see section 3.3.3 on Body Maps, Vassnes, 2009 and Andreasen, 2004:55) where he found that the brain maps and ‘feels’ the body quite different from the actual size of the body part. Here the hands are much larger than the back, reflecting the relatively small everyday importance of touch on the back. At the same time, as I discovered in my SeC project, it is important to cover the back to impress the users with a sensation of full, corporeal immersion. Even if the sensory resolution of the back is small it is therefore still important to impress the user with a sense of full haptic immersion. The exact threshold for this is an interesting question for further research.

In the sense:less project much emphasis was put on the installations psycho-physical coding, represented through the form of the installation as a strange, alien like egg or flower. The lighting of the installation further emphasised the poetry of the physical manifestation. The suit had 16 outputs built in. This was a doubled sensory output resolution compared to my cyberSM project. The vibrators however never covered much surface of the body, and even if all users I spoke to had had sensations of being touched, I do in retrospect see this as too few output zones. Then again, the number of outputs must also be seen compared to i) what kind of output, ii) How much area of the body is covered and iii) in which ways it can be triggered, for example, whether the amplitude or intensity can be gradually controlled. Many digital interfaces are only based on off/on triggering.



Figure 6-13 Sequence showing how a user is touching herself

6.4.4. Engendering tactility

Engendering senses of touch poses many difficulties. A major challenge is to produce sensations of touch that resemble being touched by another human. Reproducing and mimicking ‘natural’ touch can be described as a naturalistic approach to haptic simulation. That became my starting point in developing the first framework of what I call a haptic language. This language is the essence of forming a sensible vocabulary that is necessary in the process of making practical use of the various haptic technologies.



Figure 6-14 User reaction to autoerotic self touch. The photos were done without the user being aware of the camera.

A bodysuit with more than a hundred sensors and ninety effectors raises several complex challenges. On the one hand it is too low a resolution compared to the skin's own resolution/density of various sensors. On the other hand, how does one create a code of haptic stimuli that makes 'sense' in that it is interpreted naturalistically? The sensors by themselves function as ninety individual buttons. Just as a normal keyboard with 105 keys can create an endless variety of data input, the many sensors on the bodysuit could generate an enormous amount of data. The complexity of the task of analyzing the information from each individual button, comparing it to other buttons and then assigning the resulting function a specific effect/output was immense. To solve this was impossible within our practical timeframe. Also, from the perspective of usability, if each sensor was assigned an individual 'meaning' or function we would impose a steep learning curve for our users, the time to learn how to use the system would become prohibitively long. The system design was therefore simplified by grouping all sensory spots into five 'intelligent' regions on the suit.

These were one for each leg, one for the groin including the back and two for the chest (left and right). This grouping made sense both to simplify the construction of the system as well as making its use more intuitive. The building up to a haptic language was continued throughout the project through the assembling of codes and patterns of signs. Indications of repeatable 'trigger' sensations were found as well as patterns inducing similar responses and emotions across users. Related to the placement and use of sensors, there is little or no indication of an intersubjective, general code for understanding what a) pressing my upper right chest should mean, and b) what a vibro-tactile, pulsating sensation in the same region implies. Such problems were continuously encountered and worked out by trial and error until we subjectively felt the bodysuit somehow functioned well overall.

Over time I have developed a haptic vocabulary to model 'standard' sensations like pulling, pushing, resistance, falling, and movement from specified direction, the motion of the wind etc.

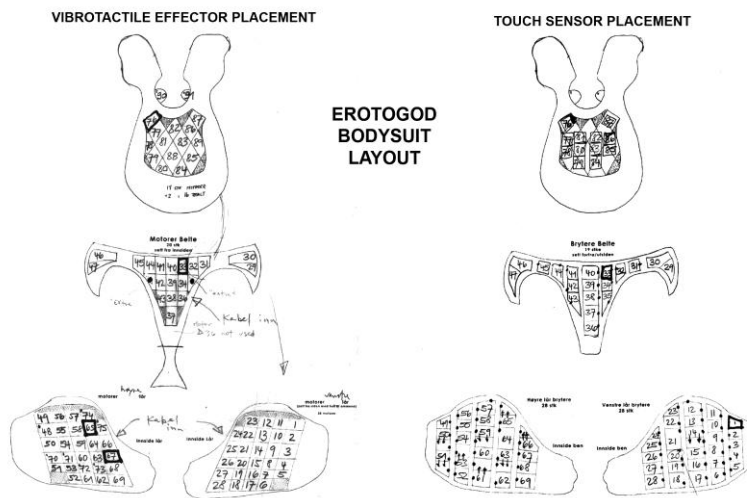


Figure 6-15 On the left the placement of sensors/input. The right shows placement of effectors/output. The suit was divided into five regions, including left and right upper vest. Both arms were later added.

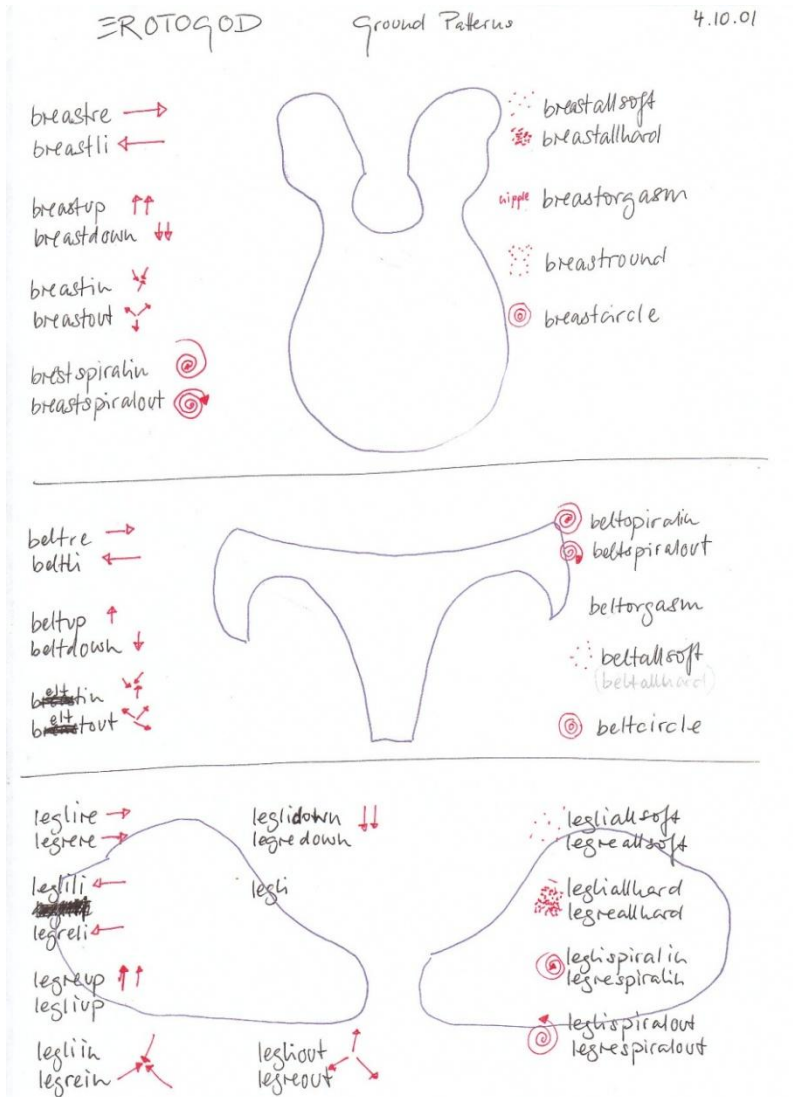


Figure 6-16 Drawing of the suit regions with names, location and 'shape' of touch.

6.5. HAPTIC VOCABULARY

A haptic vocabulary is a 'toolbox' containing different ways and methods for touching users. In Erotogod three kinds of touch patterns formed its haptic vocabulary. These were i) the ground, basic patterns used in every part of the installations dramaturgy, ii) the designed and specific patterns used for

specific parts of the dramaturgy and iii) the random patterns that were generated as response to user's touch.

In our work we had the basic vibrotactile technology for producing sensations of touch on the body, but we were faced with a simple, but fundamental problem: how to name, label and describe these feelings? The method to solve this was to do it as straightforwardly as possible. Members of the project group as well as a few invited people would try different combinations and then describe them as the sensations were primarily perceived. The resulting names and perceptions given by this eclectic reference group were highly subjective. Nevertheless, even if they were abstractions and approximations, nevertheless they could give an indication of user response or in which directions users will feel the sensations. Note also that the names primarily describe the direction and movement of the pattern on the body, not always which emotions resulted.

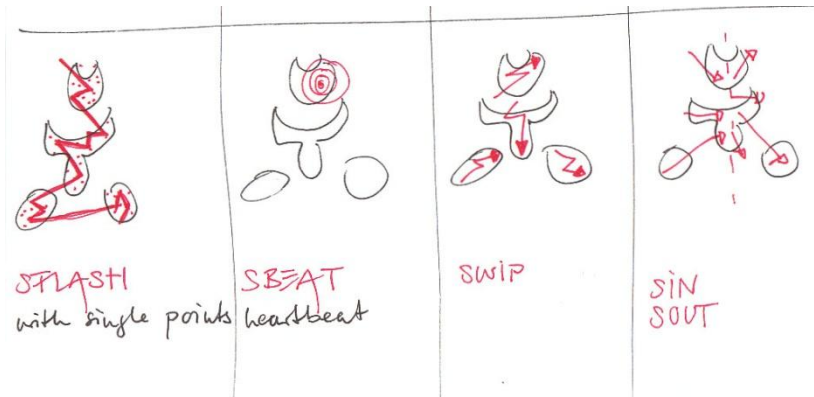


Figure 6-17 Shapes of touch: four of the 'Sin' touch patterns designed for Erotogod (see appendix for the complete document).

One example is the 'sflash' pattern, see the left illustration. Here single vibrators vibrating in sequence gives a sensation of erratic movement across the body. The 'SinSout' pattern to the right describes vibrations 'pulling' touch from one side of the body to the other. The touch we felt here would remind us of lines drawn onto our bodies. The drawings made to each sensation both serves as description as well as visual iconography helping out with the design of new patterns as well as combination of patterns. They were also the names of the software scripts. The users never see these 'touch tags'. They were made to help the various project group members' design of all the components –like sound, coding, visual effects etc. - that made up the complete installation. The resulting 'shapes of touch' patterns illustrated

above were formed into tactile taxonomy. The visual description of all patterns is found in the appendix.

6.5.1. Basic touch patterns and touch scripts

The basic ground patterns used throughout the installation's duration were either assigned to i) the upper breast/chest region, ii) the belt covering the groin or iii) the pads covering the legs. Two terms are necessary to distinguish: patterns and scripts. Patterns are general lines of touch/sensation that can be specifically *scripted* in various manners. Parameters of the scripts were time and various waveforms of effector output strength. Another common way of scripting a pattern was simply to trigger it in reverse.

i) 13 touch scripts for the breast region

Breastre (towards right)	Breastin	Breastallsoft	Breastcircle
Breastli (towards left)	Breastout	Breastallhard	
Breastup	Breastspiralin	Breastorgasm	
Breastdown	Breastspiralout	Breastround	

ii) 12 touch scripts for the belt region

Beltre (towards right)	Beltdown	Beltspiralin	Beltallsoft
Beltli (towards left)	Beltin	Beltspiralout	Beltcircle
Beltup	Beltout	Beltorgasm	Beltallhard

iii) 21 touch scripts for the leg region

Leglire	Legliin	Legliallsoft	Leglispiralout
Leglire	Legrein	Legreallsoft	legrespiralout
Leglili	Leglidown	Legliallhard	Legli
Legreli	Legredown	Legreallhard	
Legreup	Legliout	Leglispiralin	
Legliup	Legreout	Legrespiralin	

Here the name 'legli' is for German 'leg links' meaning left leg and 'legre' is for 'leg rechts' meaning right leg. The pattern 'leglidown' would then mean a sensation moving downwards on the left legpad. The user would feel the effectors trigger sequentially from the groin down to the heels

6.5.2. Haptic design patterns

In the category of designed patterns there were different subgroups:

- i) Subgroup 'INTRO' numbered 16 scripts of touch. All patterns start with an 'I' from 'Intro'. The scripts used were:

Ispoint	Isnakedown	Ileft	Ipyramideup
Impoint	Iup	Icircle	Ipyramidedown
Inline	Idown	Iall	Iout
Isnakeup	Iright	Itouch	Iin

- ii) In the 'Creation' category names started with 'C' and numbered 16 scripts:

Cpoint	Crainup	Csnakeup	Csoftout
Ccirclein	Craindown	Csnakedown	Cwaveup
Ccircleout	Cbeat	Cspiralin	Cwavedown
Ccircleinout	Cpress	Cspiralout	Csoftin

- iii) In the 'Human Being' category names started with 'H' and numbered 9 scripts:

Hstimula	Hmassage	Hpuls	
Hcircle	Hbeat	Hspiralin	
Hniple	Hlumbar	Hspiralout	

- iv) In the 'Sin' category names started with 'S' and numbered 16 scripts:

Sspasm	Smassage	Sall	Sflash
Ssnakeup	Ssnakedown	Sup	Sdown
Swavedown	Swaveup	Sbeat	Swayin
Sin	Sout	Swip	Swayout

Altogether these 103 scripts makes up the haptic vocabulary made for Erotogod performed in 2001. For the second version shown in Rotterdam in 2003 another 25 patterns/scripts were added. The duration of each script lasts from a few seconds up to a minute. They can be triggered individually, in sequence or in combination with random patterns. The number of combinations resulting of this vocabulary is immense and the Erotogod project only scratched the surface of what is possible to express through such combinations.

The names of the touch patterns/scripts reveal which touches were emphasized and so indirectly tell a story of what impression the installation aimed at reproducing. However, they were mainly designed as singular patterns, but in the installation they were triggered in sequence. Patterns were

therefore mixed and the resulting sensation hard to plan or foresee. The final installation is therefore also a result of trial and error.

6.5.3. Tactile fidelity

As signposted in chapter one, what effect does a higher sensory resolution in bodysuits have on the experience of tactile fidelity? First of all, what is ‘tactile fidelity? Paterson describes the fidelity of feeling as the sophistication of sensations (Paterson, 2007:12). In relation to the somatosensory system fidelity is described by Nelson (2002:244): ‘fidelity in tactile sensation is not unlike that in music’ and, as he continues with a citation by Chris Dobrian: ‘In playing a single brief note, a violinist combines bow angle, bow speed, bow pressure, in addition to whatever totally involuntary muscular movements may be caused by nervousness, coffee consumption, humidity, unknown electrical discharges in the brain, etc – and all of these factors are changing from millisecond to millisecond’ (ibid, p. 244). This quote portrays how many subjective factors that influence how we perceive. However, having a high fidelity can possibly reproduce sensations with a much higher degree of exactness, thereby reducing the possibility of multiple meanings of expressed touch. We can expect a higher fidelity to reproduce haptic sensations better. In relation to touch conveyed through external machinery like grasping actions with the Phantom device, a greater fidelity is likely to make it easier to mimic the touching of real objects (Paterson, 2007). In the context of bodysuits where less instrumental and more humanlike touches are produced, a higher fidelity can contribute to a broader range of expressivity. This is what I observed in the increase from the 16 vibrotactile outputs of the *sense:less* installation to the 90 of SeC. However, these observations should be tested over time and cultures.

Most current commercially available touch technologies have a fairly low fidelity. What then does low fidelity in haptics mean? Experiments with single vibrotactile outputs like the vibrations in a mobile phone shows that low fidelity can come to mean many things, based on context and coding (Paterson, 2007:133; Shin, Lee, Park, Kim, Oh and Lee in Smith & Salvendy, 2007:1174). A translation of, for example, the Morse code language into sequences of longer and shorter vibrations (Ferre, 2008:933) could prove to be a Tadoma like language with a vocabulary and expressive potential no less than writing. Low fidelity can therefore come to mean many things and also, despite its simplicity, contribute significantly to the experience within media-based installations. This is comparable to McLuhan’s hot versus cool media and the media richness theory (section 4.6.7). However, there is a lower limit for how few sensors can reproduce certain patterns of movement. Even if the SeC and the Erotogod bodysuit are above this threshold, their haptic

resolution is still low compared to, for example, the density of receptors in the skin.

6.5.4. Haptic and tactile resolution

It was my experience that it is much easier to create a variety of impressions of touch with 120 zones of touch in the bodysuit of the Solve et Coagula project than the 16-zone resolution of the sense:less project. Therefore there appears to be a sensory threshold for when haptic stimuli can create meanings or not. It is necessary to clarify the difference between a haptic or tactile resolution. Tactile resolution refers to the number of effectors used and haptic resolution refers to the sensed effect of these effectors. As signposted in section 5.6, haptic resolution can be defined as the number of stimulants triggered according to patterning of movement over time. This can formally be expressed as:

$$\text{Haptic resolution (embodiment)} = \# \text{ haptic stimulants} \\ (\text{effectors}) \times \text{movement} / \text{time}$$

Haptic resolution can further be defined as how much area of the body is being stimulated at what intensity and by what stimuli. Haptic resolution can include all kinds of effectors. Tactile resolution can therefore be seen as a special instance of haptic resolution. If there is only tactile stimulation available, then haptic and tactile resolution is the same.

The Erotogod suit has a vibro-tactile resolution of 120 zones each haptically influencing an area of the body of approximately five by five centimetres. A zone is comprised by a custom-made vibro-tactile vibrator where a micro motor served as the main effector. Each effector was individually controllable by the analogue interface and variable in strength from the slightest shivering to intense vibration. The zones were designed to be fairly equally distributed across the body apart from the thighs. The Erotogod suit has a resolution that can reproduce the ‘exploratory movement’ that Merleau Ponty deemed necessary for recognizing sensations of touch like roughness and smoothness (section 5.6). As will be discussed in chapter seven, users felt ‘embodied’ and included, i.e. immersed in the Erotogod system.

6.5.5. Optimal tactile resolution (OTR)

The optimal tactile resolution can be described as the triggering of a chain of effectors so that sensations such as continuous movement are experienced by the user. This relates to the Tau effect (section 5.3.1). The question is whether this varies in different areas of the body? According to Penfield’s bodymaps we should sense more and more refined variations in certain areas of the

body. The questionnaires were not targeting this issue but as the evaluation of the bodysuit was better than expected it is reasonable to assume that the bodysuit come closer to an Optimal Tactile Resolution (OTR) than not.

What is possible to tell or feel with the haptic resolution in Erotogod? From a physiological point of view and compared to the average human user, how fine is the human sense of vibrotactile resolution? In line with the Vibratense findings, recent research has shown that even a 3 times 3 vibrotactile array allows for recognition of the alphanumeric letters (Yanagida et al., 2004). If these findings are correct, then one should be able to implement a vibrotactile –Braille system mounted on a finger. Such implementations could turn the resolution given by the buttons of a standard four by three button mobile phone display into a book for the blind. Or perhaps a haptic based movie screen on the go? As Bach-y-rita's experiments on tactile visuality shows, this could help blinded people regain the ability to see (section 4.6.3). The actual haptic resolution in the Erotogod bodysuit was high, but the factual implementation focused more on giving users a holistic experience of sensory immersion, not trying to model specific and naturalistic behaviors.

A critical question is which other psychophysical moments could influence what users sensed. There are several sources of error when trying to measure the effect of vibrotactile effect. A high pitch, almost whining sound was emitted from effectors when they were triggered. The users so became used to hearing sound and feeling the touch at the same time. Through some kind of conditioning to stimuli it is possible that some of the participants interviewed did not actually sense what they did, but what they thought they did. On the other hand, their time inside the installation was too short for users to familiarize themselves with the installation in depth.

Optimal Tactile Resolution enables the matrix of effectors placed inside a bodysuit to create a Tau like sensation of continuous movement around on the body. To achieve this, the haptic resolution must be in the range of the Erotogod suit, approximately 100 effectors spaced evenly around the body.

6.6. HAPTIC LANGUAGE

With such a relatively high two-way sensory resolution in a bodysuit, the possibility of developing a haptic language presented itself for the first time. This density of touch zones enabled the construction of complex sensory patterns to be imprinted on the body. As in the SeC project, to better design these haptic patterns the 120 effectors were mapped out onto a 3D drawing of the body. On this image I visually drew the various touch patterns so that we could more easily code them into the computer for testing. The patterns were designed both in sequence of zones triggered and the individually variable strength of the effectors. The design of the patterns varied from string like,

linear triggering of the effectors to larger areas being triggered simultaneously.

The haptic perception induced by the patterns varied. Our haptic vocabulary has over time developed into a toolbox able to create distinct sensations from being pulled, pushed, resistance, weight, (human) touch, tickling to objects and ‘insects’ crawling around on the user’s body. We also tried to induce sensations of things going inside as well as through the body. Most users had an impression of the suit as being alive. It was felt as a Live Skin on the body. To maximize the physical effect of each effector it was important to get it placed as close and firmly onto the skin as possible. More effect is achieved if users are naked beneath the suit, but due to the number of participants and for hygienic reasons we let them wear light clothing underneath. The strength of the effectors is clearly felt even then. The custom built interface has a maximum electric output of ten amps. When most of them were triggered the users were given a strong corporeal sensation of what the power of a watt can feel like.

How is a haptic language composed? Having designed and built the suit for a kneeling user, the design and testing of the touch patterns was started. This was done without coupling them to sound or visuals. The work with touch-pattern design was mainly done by one of the project assistants. She had both a higher education within new media and had worked as a prostitute for many years. It was her explicit interest to apply her distinct and special corporeal knowledge of the body as a tool to reproduce sensual experience. Her task was to design effective ‘touches’ according to the dramaturgy and emotional span that the installation would provide. Effectively she gave the users an imprint of her body sensations. This could in poetic terms be read as a SimStim sensation (section 4.5.1) of being inside her body. Her work with the touch patterns became an important element of the final Erotogod experience. She developed experiential touches and patterns that I as male probably could never have made. In relation to males she developed a different impression and sensation of being inside the sensual world –and body- of females. Her work was developed over the span of six months.

Developing touch patterns was not just done by ‘free feelings’ and improvised mapping of autoerotic touch. It was also done by drawing patterns on a 3D map of the body and effectors.

These patterns were then analysed and discussed before coding them into the computer. The coding was done by a simple script language, signaling which of the motors from 1 to 128 would trigger when, for how long and at what strength/amplitude.

The touch patterns were then tuned and modify before other users tried them. In the course of this work we developed a quite intuitive understanding

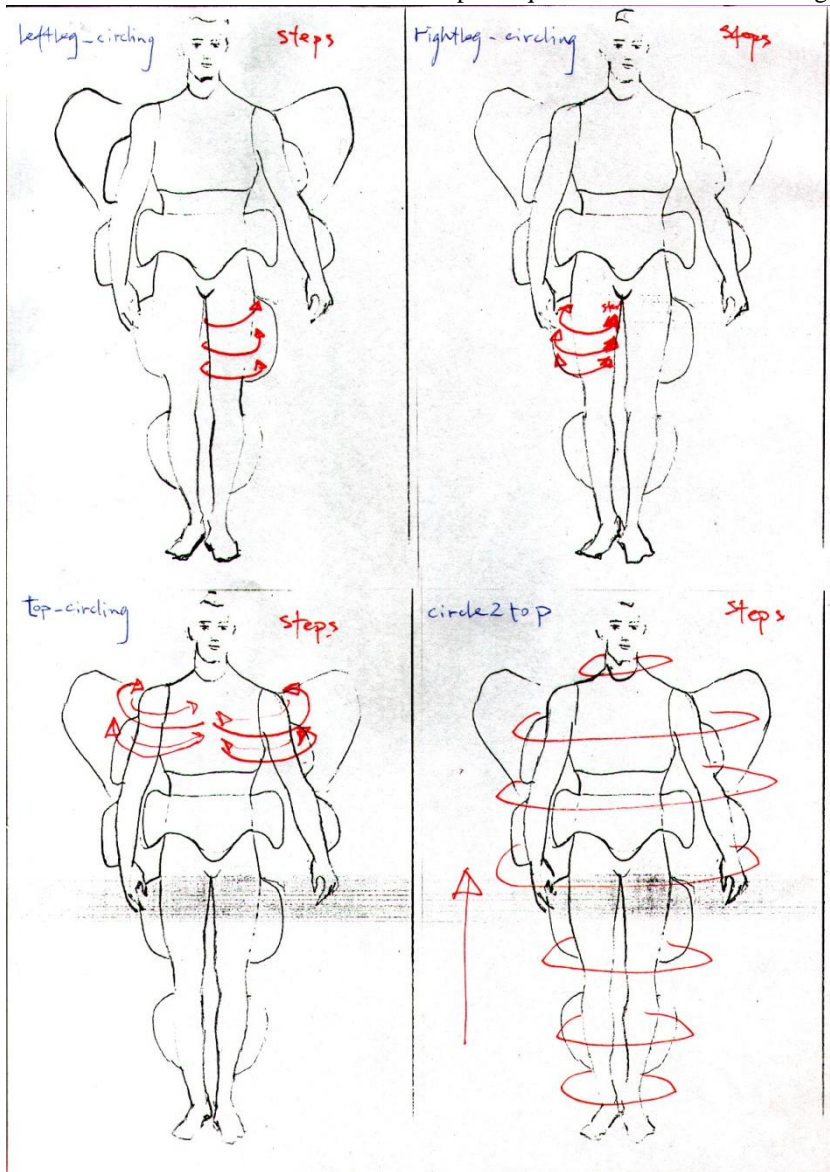


Figure 6-18 Drawing of patterns from the Solve et Coagula project.

of what a pattern on paper would feel like inside the suit. This experience indicates again a possibility of both building and learning a haptic language that is recognized across larger communities. One interesting finding was that several of the patterns we developed also functioned as experiences on their own. Being inside the suit without any other stimuli could be an experience of its own. This was partly due to the fact that we spent much time making the touch patterns, but also due to elaborate pattern design with much use of curved (varied) adjustments of the effectors strength. The sensations inside the suit alone would range from brutal to elegant.

How were the designs of sensations received by users? How was pleasure, for example, recognized? This is as chapter three (section 3.3.2) discussed, not just an issue of haptic technology, but dependent on several parameters and issues. For example, in a study of the meaning of touch, Nguyen, Heslin and Nguyen found that for the psychological comfort level of intimacy of a) non-verbal behaviour and b) the social relationship of two people must be congruent (Heslin and Alper, 1983). If the installation is subjectively perceived as disharmonious there is little chance of the user to feel pleasure from (potentially) pleasant patterns.

6.7. MULTIMODAL TACTILITY

A certain haptic resolution is necessary to develop sense out of haptic interfaces and stimuli alone. In my first bodysuits the touch by itself was felt as a fairly mechanical and abstract stimulus. In *ErotoGod* the users could now make content out of the bodysuit as a stand-alone application. The multimodal combination of sound, visuals and touch provided the necessary multisensory bandwidth to expand the range of expressions possible. As discussed, sound can indeed be used to create corporeal sensations. Returning to the art noise band Granular Synthesis, their extremely loud video/sound/noise installations 'Model-5' was shown at the Electra exhibition at Henie Onstad Art Centre in 1996.¹¹⁰ I took part in one of their performances and witnessed how the sound in this installation was so loud it would both make the body quiver as well as physically hurt the ears.

ErotoGod implemented physical sound in a much more indirect way. It used 3D sound to create aural movements in the space of the installation. This was thought to help the user as points of reference to navigate to/from and help him/her to feel at ease. In practice it is hard to map a physical installation, 3D visuals and sound precisely together. Several factors must come together to build a completely controllable environment. One of the problems here is the need for a larger, reflection-free space to ensure a higher degree of control over sound positioning. Too much reflection of the sound in

¹¹⁰ <http://www.medienkunstnetz.de/works/model-5/> accessed on March 4th 2010.

the exhibition space makes it hard for the user to sense where the sound is coming from. However, even if the sound was less of a navigational helper, it did have a corporeal effect on the body. Having powerful speakers and subwoofer at hand, the 3D sound filled the space with an aural density that we could mould to having corporeal affect, adding to the sense of immersion.

6.7.1. Sound

Having the user kneel down places her/his head directly inside an audio-sphere consisting of sixteen loudspeakers. The loudspeakers are spherical positioned and pointing toward the users head to create a physical, 3D and 16 channels audio system.¹¹¹ The musical experience is made to be spatial and corporeal as well as developed interactively together with the user. The autoerotic self-touch of the user is used to compose the three-dimensional music. The composition was a result of i) user activity, ii) system state, iii) timeframe position and iv) system 'intelligence'. The music is played back by Erotogod's body-manipulative sound-system. The 16 separate channels /loudspeakers that make up the three dimensional audio-sphere renders the experience of sound corporeally real. By moving and rotating sound patterns the installation attempts to physically manipulate the user to feel new perceptual phenomena. We attempted to induce perceptions of sound as moving through, around and spiralling down on the user.

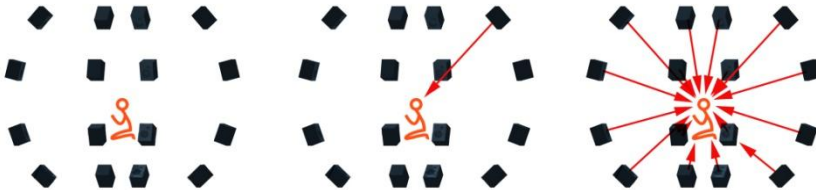


Figure 6-19 Illustration of how the 16 loudspeakers were placed to be centered on the users head and centered towards user's ear.

The sound heard is based on real time compositions made through the technique of Granular Synthesis (Russ, 1996:252) (the name is not to be mixed with the artist group). The raw sound material that is fed into our real-time system were small, second long excerpts from a recording of intercourse between a heterosexual couple. The couple was wired with several microphones to acquire realistic and recognisable sexual and corporeal

¹¹¹ The real-time sound composition is written with Max/MSP. It was rendered on a Macintosh G4 1.2 MHz with 16 channels audio out.

sounds. To get as natural sounds as possible the couple was selected because of their long term experience with theatre and technology. They expressed that they did not experience the wiring or their knowledge of the recording as intrusive. I therefore assume that the raw sound material is fairly, if not completely, naturally sounding.

A critical element is how successful the perception of the immersive sound was. The sound patterns were felt physical and directional, but not to such a degree as expected. Some of the critical issues influencing user perceptions are sound level, impact of resonance from the surroundings and sound quality. The sounds projected were fairly abstract and personally I often perceived the patterns we used as ‘smeared’ out over several loudspeakers. All in all the 3D sound was a partial success, but in need of more development time to develop distinct directionality and space distorting effects. Another critical question is what would have changed with i) 24 or 32 or more loudspeakers, ii) fewer, for example, 8 or even iii) through binaural rendering listened to via headphones. This represents an interesting research area for future projects.

6.7.2. Visuals



Figure 6-20 The user kneeling inside the installation. Illustration right: a view of the user from behind, watching the frontal projection.

The user was immersed in a three screen projection set up. The virtual, real time graphics projected onto the front were abstract, colourful and full of movement. The more or less abstract graphics were composed by words and

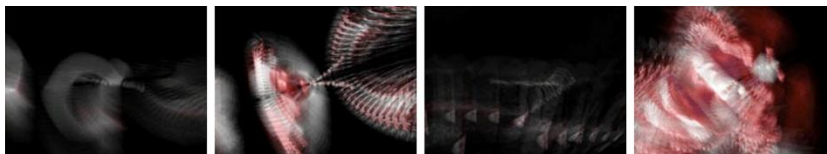


Figure 6-21 A four image sequence of how the 3D graphics based on words and projected on the front screen is rendered and changed.

letters. For the front projection the words that the user ‘wrote’ by touching the suit were used like pixels to build the visual output. The visual expression was focused on creating a dynamic and graphical textual expression did that not necessarily have to be read as text, even if it partly could be.

The actual text the user produced was seen as readable words and sentences in a second 3D rendering projected on the two side screens. The 3D visualizations were rendered by our own program written in Open GL. All of the visual expressions were made as a combinatory result of the user-to-system interaction. As with the sound, the recombined text was a result of i) user activity, ii) system state, iii) timeframe position and iv) system ‘intelligence’ (software). The new, user-based myths appear as three-dimensional sound, graphics and corporeal experiences. Together these expressions make a synaesthetic experience, a multisensory story where the combinations of multiple sensual modalities attempt to create a larger impression. The content of the texts were recombinations of text-excerpts taken from the religious creation myths of the Thora, the Bible and the Koran.

How successful were the visuals in this multimodal context? Could they have been changed to effectuate a stronger or different sense of immersion? The texts projected on the main, front screen were drawn in a movable and changing manner that made them hardly readable. From a semantic point of view they were therefore not directly intelligible. However, it was the recombination of the various fragments that from an artistic point of view was of interest in this set up. For the text to be readable was not seen as a critical moment in understanding or experiencing the multimodal expressivity of the installation. It would however have been interesting to have had a

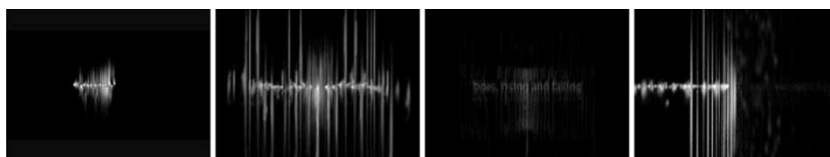


Figure 6-22 A four image sequence showing how the 3D text projection on the sidewalls is rendered and changed.

clearly readable text projection to correlate with the results of the questionnaires.

6.8. HAPTIC PLEASURE DESIGN

Touch and pleasure belong together. As Yi-Fu Tuan says, both the pleasures of being alive and the deepest sense of wellbeing depend on cutaneous rewards (Classen, 2005: 75). Further, the sensation of pleasure is in itself the most self-affirming and self-transcending of experiences (ibid, p. 69). In contemporary culture we experience an increased sexualization of the sense of touch (ibid, p. 71). More often than not, this inhibits our use of touch. As discussed throughout this thesis, touch is an integral part of our Lifeworld. Only some forms of touch are directly sexual and need not narrow our minds in relation to ordinary pleasures such as the touch of a friendly hand (ibid). In our research that covers a wider field, a main question is how a variety of corporeal pleasures can become an integral part of interactive experiences and to form a *tactile aesthetics* (ibid). The focus on the design of haptic bodysuits relates to questions such as: How can corporeal pleasure constitute the user experience? How can the sensations of the body be understood as an artistic and design specific ‘material’? And, can we aesthetically manipulate our bodies to sense a physically reproducible pleasure? How can the body be experienced as a canvas of sensations? Or even a design product?

Erotogod is also an affective system. How far does it follow the pleasure principle (section 3.3.2) and produce pleasures in the users? A critical question would here be to ask which of pleasure’s different shades and variations one seeks? As mentioned above, one dimension of touch that is often sought is the pleasure of social, caring proximity. Facing the lack of affectionate and intimate body contact in contemporary society, the American futurologist John Naisbitt calls for a new touching behaviour called ‘*high touch*’ (Jütte, 2005:239). Following his observation that our high tech society lacks proximity and near-body contact between humans, high-touch is about reconnecting bodies and producing closeness and togetherness. How does one produce the maximum of intimate and personal contact without harassing others? How not just use haptics to make contact with others, but also produce pleasant touch through haptic technology? Haptic pleasure design is about producing specific sensual enjoyment through corporeal stimulation.

During a visit to Florence in 1817 the French novelist Stendhal was so struck by the immense artistic beauty that his body went into tremor. He experienced a form of aesthetic ecstasy. This was later defined as the *Stendhal Syndrome* by Italian psychiatrist Graziella Magherini. Symptoms of the syndrome are erratic heartbeat, dizziness, confusion, breathlessness, panic attacks, fainting to the floor and hallucinations when one is exposed to art. As with Kant’s notion of the sublime, the syndrome might not necessarily appear

as a pleasant experience there and then, but time and distance can change awe and startledness into an aesthetical pleasure. This is *the experience of autonomy* (Kant, 2005:38) (Gilbert-Rolfe, 1999: 45): when an awesome and ‘sublime’ corporeal experience is digested over time by a rational being it will most likely *reappear indirectly as pleasure* (Kant, Critique of Judgment: 68). When ones expectation dissolves it might even result in a sensation of delight.

And indeed Stendhal’s epiphany implies a strong dimension of overwhelming pleasure. On the other hand one can ask in how far this was a learned experience in line with Bourdieu’s notion of cultural knowledge (section 3.4.1 and Levinson, 2002: 121) and how it influences our corporeal experience, epistemological reflection and cultural condition. Was Stendhal’s reaction simply due to a culturally refined aesthetic perception? In Bourdieu’s view we possess a certain cultural background that enables us to experience something as something. This becomes a referential background for our culturally coded interpretation. Contextually it appears as if Stendhal’s experience is perceptually preconditioned through culture. It appears as in Bourriaud’s relational aesthetics (2002) where the viewer is not in front of an art object anymore, but through a set of relational and cultural codes included in the process of its construction.

Another question is in how far Stendhal’s ecstasy produced a pleasant corporeal experience? What happens if we expand the artwork’s visual appearance, and impress it directly on the user’s body? How can the culturally-coded mental ecstasy of Stendhal become a real, living, physical ecstasy?

Returning to Bourdieu’s notion of cultural knowledge it would be of interest to test the hypothesis that *corporeal reactions to works of art are possibly more similar and intersubjectively understandable than culturally coded reactions*. This hypothesis sets biologically given parameters above cultural influence. It is interesting to test such a hypothesis in the field of art and aesthetics because it represent, sensorially speaking, a substance of its own: ‘Art is in general the only bastion which is not blinded by the business of deception (Schein). In art, deception (of the senses) is shattered because art in itself is deception’, -R. Bubner, 1973.

Haptic sensations produced by touching technologies can be understood as ‘artificial’ as they simulate some kind of touch. The vibrotactile simulation used in my projects need not necessarily be anything more than that what they appear to be, that is mechanical vibrations. Even when touch is a simulation, it is still a touch of some kind. Technologies such as bodysuits create a layer between the subject and the experience. This distance makes it possible for the body to experience so to speak for itself. This again can be considered a phenomenological experience of corporeal autonomy. In

Kant'ian terms, haptics so cause aesthetical pleasure and form the basis of tactile aesthetics.

Both my observations and user's response (section 7.7) indicate that most users react corporeally similarly to the same pleasant haptic stimuli. However, the research material collected here is not focused on answering the above hypothesis (see also section 8.2.4). To test if the perception of pleasure is a common corporeal denominator across cultures is nevertheless an interesting topic for future research.

6.8.1. Visual touch

In Stendhal's case simply gazing at artworks creates such a strong mental reaction that it triggers corporeal reactions. And indeed visual impressions can be pleasant to the senses. An example is again Olafur Eliasson's *Weather Project* (section 2.3.4) where the massive environmental installation filling the immense halls of the Tate Modern, produced 'Stendhal' like experiences for many users. Such strong corporeal reactions are rare in a relational art and design industry dominated by visual products. Was the reaction to the project caused by the visual impression or by reaction to direct physical stimuli? One reason for audience' response could be the way the light and reflections encompassed the users, visually submersing and even embodying them in the artwork. In an embodied, phenomenological context this lead to the question of when the exclusion of direct, physical body stimulation from the user's (art) experience can be seen as a limbic loss equal to castration. The haptic as a 'material' for artistic experiences is a literally barely touched dimension and represents a potential for the production of new kinds of expressions and products.

But why is the haptic domain hardly explored? (Classen, 2005:2 and Paterson, 2007:2) Our culture is still captive by the craving eye. Visual expressions dominate our experience economy – as we know it from the theater, the movies, opera, design artifacts, museums, TV and the internet. We are all fetishists of the image. Often we look at other 'primitive' cultures as superstitious cultivators of the iconographic, but strangely enough we are ourselves oblivious toward the daily influence of our own icon- and logo industry. That we are ourselves - sensorially speaking – almost one-dimensional does not fit in with the wishful portrait of a modern, advanced and rhizomatically (Taylor, 1998:107) connected society. Our visual culture makes itself into a superficial society. Our ideals of beauty as well as body culture and pornography are built upon the surface and visual appearance of the body. The inner, experiential sensations and experience are left invisible and are therefore considered as less 'important'.

Although our perceptions are arguably cross-modal (Paterson, 2007:55), we perceive our bodies as almost exclusively monosensory, as ocular. Even if

that can create strong physical reactions as in the *Weather Project*, in most visual contexts we react superficially, leaving the artwork for (sur)face value. Despite an ever increasing art market, there are few if any reports of Stendhal syndromes, suggesting that direct corporeal reactions here usually escape us. The dominance of the visual stimulates further superficial gazing practices. As Aristotle points out (ibid, p.17), touch is acknowledged as prior to the other sensory modalities. As such it represents a possible bridge to the Cartesian gap between mind and body. As Merleau-Ponty points out, our body thinks as a complete unit, not with singular and separated senses.

6.8.2. Haptic hedonistic technologies

So how does one use haptic stimuli to design haptic pleasures? What haptic technology makes which sensation possible? Haptic and multisensory systems dealing with pleasure can be traced a long way back in fiction and fantasy. As discussed in chapter four, several of the significant images and visions on haptic technologies within popular culture, literature and film have had an effect on the way we think and act with technology. As discussed in section 4.5.1, culturally-rooted inspirations are Huxley's 'Feelies', 'The Excessive Machine' from the film 'Barbarella' and Gibson's 'SimStim'. An interesting test scenario for a future SimStim would be how to haptically stimulate users to feel a Stendhal-like tremble as he did before the aesthetical beauty in Florence.

But pleasure is not a single kind of experience. Haptic pleasure and haptic pain are related. That pleasures come in many forms and variations is wonderfully illustrated by the *Painstation* project by Volker Morawe and Tilman Reiff.¹¹² This subversive work of game design is built as an arcade game where two players compete against each other based on the older *Ping Pong* version (table tennis). The haptic interface had a simple design:

‘During the game, the players place their left hands on the PEU (Pain Execution Unit) which serves as a sensor and feedback instrument. Possible feedback effects are heat impulses, an electric shock and an integrated miniature wire whip. The feedback generated is dependent on the playing process and can increase in its intensity’.¹¹³

Literally this work is about the pleasure of pain. During the Norwegian *Detox II* exhibition (2004) several users were observed happily laughing and playing to the point of bleeding and screaming. The social and competitive instincts take total control of users and make them into ‘suckers’ for the

¹¹² <http://www.painstation.de/> accessed on March 10th 2010.

¹¹³ <http://en.wikipedia.org/wiki/Painstation> accessed on November 29th 2009.

pleasure of (haptic) victory – or simply the joy of feeling alive. The project certainly represents a ‘disturbance that affects the whole body’ (Timaeus, section 3.1) and appears to go against the pleasure principle. However, as discussed in the corporeal affordance section in chapter five, the construction of meaning must be understood from its socio-cultural and contextual point of view.

In the ‘Mobile Feelings’ project by Sommerer and Mignonneau (section 4.7.5), vibrotactile stimuli is used to communicate a sensation of touch. The project can possibly create strong sensations of pleasure through friendly care and proximity. Yet, these are not really hedonistic pleasures. They are more about exploring some of the possibilities of pleasure than taking them to the extremes. What about works that deliberately work with the induction of ecstatic corporeal pleasure in the participant? How does one intentionally and directly produce art experiences that cause a real Stendhal syndrome?

6.8.3. Hedonistic bodysuits

How can bodysuits be built to meet the challenge to practically create and reproduce specific, physical and sensomotory sensations like pleasure? Sensations of pleasure are often associated with the (cutaneous) skin and its many functions. Skin is both aesthetic as a surface for display and functional as a tool to sense. It is a perceptual gateway to physical reality. Bodysuits as in the cyberSM project use skin as an intersensorial surface to serve as a basis for sensual excitement. The physical dialogue made possible by the cyberSM bodysuits included nipple, anal, penile, and vaginal stimulation. In terms of pleasure, sexual feelings can be provoked through a combination of visual stimuli and vibrators. This has a certain degree of sexual brutality, and putting a dildo in/up your groin is not always necessarily pleasant. Or wanted. But the playfulness and multisensory sensations of cyberSM compensated for the brutality and most of the participants observed reported having had a good experience.



Figure 6-23 Erotogod bodysuit in action, DEAF festival, 2003.

Autoerotic pleasure through synaesthetic combinations was one of the themes of Erotogod. Erotogod attempts similar synergetic linking of stimuli as in the e-skin project by Jill Scott (section 6.2.2) that combines touch with hearing. The aim of this is to facilitate an action-oriented, multisensorial environment that promotes synaesthetic and pleasant experiences. One of the goals is a better and more persuasive perceptual manipulation of the participants. The synaesthetic also encourages experiencing unexpected combinations. The sound of Erotogod is based on breathing recorded during a sexual intercourse. The users' autoerotic touches hence produce a live sound composition reproducing the original intercourse aurally. The tactile patterns expressed in the bodysuit are all re-combinations of pleasant sensations felt

and recorded by a female prostitute. Her professional skills were important to the design of the better touch patterns.

6.8.4. World Ripple

My ongoing World Ripple project builds physical sculptures out of emotions rendered real. Through a haptic system the artistically emotional and ‘virtual’ content becomes physically experienced. It is an invisible, immaterial sculpture made sensually sensible by a tactile, wireless, mobile bodysuit and binaural sound system. The sculptures are triggered by GPS coordinates. They are expressed as physical stimulations and sound-based compositions. The sculptures of World Ripple are experiential –and sensed - in the open, outdoor landscape. As computer-generated structures they can be endlessly large and dynamic experiences that can cross, be sensed around and encompass the world. The users wear a transparent, body-based and visually hidden system. The bodysuit is worn underneath the ordinary clothing and has currently in version 2.0 a resolution of 64 puls modulated outputs controlled by an Arduino board. The mobile, sensor- and GPS-based computing system is carried in a shoulder bag. Walking through the world users will sense and interfere with the sculptures.

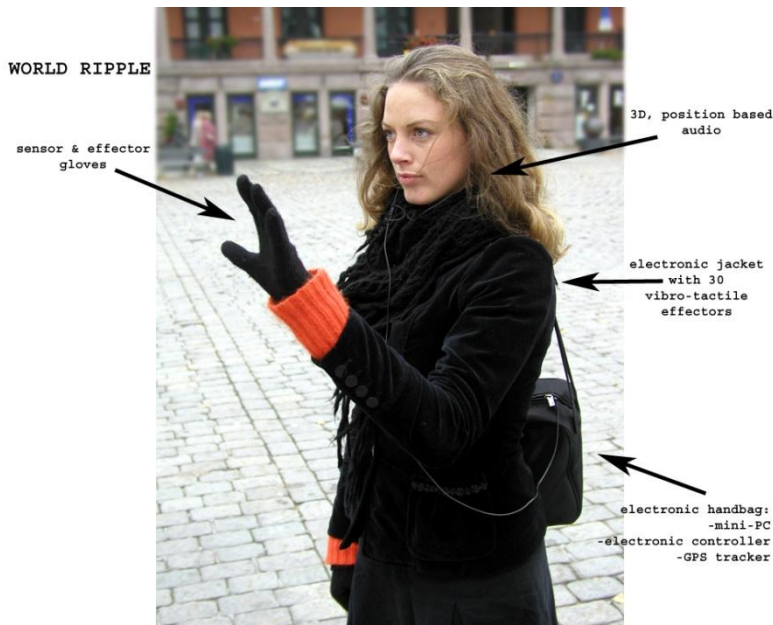


Figure 6-24 World Ripple version 1.0 system set up.

World Ripple combines computer-constructed structures with the existing, physical and real landscape, and is therefore a ‘Mixed Reality’ project. It is a corporeal interface where none of the interaction is screen-based. The project focuses on the individual, body-oriented spaces of experience. The parameters enabling the user to experience the immaterial sculptures are mainly location and behaviour (orientation), but also personal profile (individual needs) and biometric data (personal condition). The user experiences the sculptures as combinations of different tactile patterns triggered in the bodysuit. These stimuli give the sculpture texture and strength. The shape of the sculpture, that is walls, borders and consistency are rendered through different combinations and strengths in the effectors of the suit (vibrotactile stimuli). Different sound patterns and recordings are triggered and played as the user meets and affects the sculpture. This combination of physical stimuli with sound gives a strong and immediate sense of physical consistency and spatial experience.

Feedback from users indicates that the use of bodysuits -as in other my projects - represents one of the most direct ways of inducing the body with the sensation of corporeal pleasures. Even if the suits do not necessarily reproduce the ecstatic sensation as Stendhal reported, as artifacts they represent a step towards an art- and design-specific way of producing pleasures as experience and perhaps even a product in itself.

Phenomenologically interesting is the layer, that is the distance between the subject and the experience, which the bodysuit creates. This estrangement makes it possible for the body to experience for itself and can therefore be considered a phenomenological experience of corporeal autonomy that in itself can reappear indirectly as pleasure.

6.9. HAPTIC STORYTELLING AND NARRATIVE

One result of the experiences with the bodysuit can be summarized with the term haptic storytelling. This means the telling of stories through haptic stimulation. Haptic storytelling is coined by the author of this thesis and might be seen as a new concept in the creation of immersive media art.¹¹⁴

This thesis uses the term storytelling as synonymous with ‘narrative’ (a tale, story), however since ‘haptic narrative’ is used by the cinema arts, I prefer haptic storytelling. Haptic storytelling starts with the assumption that the biological conditions of the human body do not only support cognitive processes, but also cultural adaptations including narratives (Bruner, 1990, see also Bourdieu in Becker, 1995:28). Understanding these conditions, including those found in the nervous system and represented by working

¹¹⁴ Stephen Barrass (2006) has used the term to describe haptic experience in combination with audio-based storytelling (story = words/sound + touch), see chapter 3. My approach is conceptually different in that it is storytelling through haptic stimulation (touch = story).

memory, speed of processing, and so on, may in turn clarify certain cultural aspects of narrative functioning itself (see also Dreyfus & Dreyfus on affordances in chapter 4). Humans reflect embodied actions emotionally and emerge from an interaction of physical gesture with narrative *emplotment* (Ginsberg & Sarbin, 2003). This assertion may also be related to Lakoff & Johnson's claims on the origins of metaphors in early bodily experiences (Lakoff & Johnson, 1980, 1999). Peterson & Langellier (2006) give the link of body and story a more general character by arguing that:

narrative requires bodily participation in listening and speaking, reading and writing, seeing and gesturing, and feeling and being touched. In all of these instances, some body performs narrative (ibid, p. 175).

For them actions and re-actions of the body, stand at the center of both narrative production and reception.

Besides reasoning for the significance of the relationship between the story and the body from embodied emotion and biosemiotic perspectives – what role does this play for this thesis? Storytelling is here used in the meaning of an ‘account of some happening’ or a ‘narrative of important events’. Telling stories is intrinsically interwoven with the local circumstances of the story telling, their affordance (Dreyfus & Dreyfus in section 5.8) and issues such as Bourdieu's habitus, that is a *modus operandi* (Swartz and Zolberg, 2004:66) or a habitual or typical condition particularly of the body. It demands a certain kind of context and establishes a kind of interactive reality. Thus, narration can be seen as interaction, a contextualizing activity. An important part of this context is bodily experience through a narrative medium. From the body's perspective, a story starts to develop *as it is felt*.

Eroto-god is one such story. It is, as the introductory text to the project states, printing words as sensations on the body. Here, the body is no passive screen, but a reflexive entity being molded between the user's autoerotic self touch and the installation's touching back. When touching him/herself the user ‘writes’ stories of touch on the sensors of the suit. These touches are ‘heard’ by the installations software, interpreted, rewritten and ‘told’ back onto the body through real-time combinations of the haptic, vibrotactile vocabulary. This two-way looping of touching makes up the haptic storytelling in practice. Here, in haptic storytelling, human nature is not perceived as biologically passive, not instinctual (though not free from instinctual components either), but active, an ensemble of physical, historical and cultural interactions. According to Mark Turner: ‘narrative imagining – story- is the fundamental instrument of thought’ (in Ryan, 2004:3). Narrative

is fundamental to cognition, because when we ‘notice objects or events in our perceptual environment we construct embryonic stories about them’ (ibid). The embodied combination of touch and thought underlines a vision of haptic storytelling

The concept of autonomy of the body in the last section perceives corporeal existence as a possibility to revitalize the human condition and experience by focusing upon the *physis*. The reason for that is that body is ambivalent. According to Keith Tester, and in line with Adorno, the body has a first and a second nature. The *first nature* is its existence as a natural material object with a physical presence. The *second nature* is the body understood and mediated through socially and culturally learned ways. Combined they possess the ability to confirm and simultaneously undermine social and cultural values (Tester, 1995:141). This twofold description of the nature of the body is also found in Ihde’s notion of *body one* (phenomenological) and *body two* (cultural) (Ihde, 2002:xi). One critical question here is if such views are introducing another dualism. In haptic storytelling the case is that a story engages both mind and body simultaneously. If we investigate the ‘first’ and ‘second’ nature through phenomenology, they can also be understood as affordances. As such this concept of autonomy exerts important influence on the combined psychophysical repository contributing to the haptic domain.

Adorno and Horkheimer claimed that the culture industry and the media have transformed the possibility of enlightenment to the possibility of barbarism. The commodities produced by the culture industry may be trivial, but their effects upon individuals are devastating. Ironically, the new, immersive media art shows that media can also counteract the culture industry and their ‘fake’ experience manufacturing - through creating ‘fake’ experiences. Artistic use of haptics to tell corporeal stories is an individual way to question the reality and form of bodily experiences. It bridges the gap between mind and body from a personal and corporeal perspective, not through ‘rational’ thinking. These moments of experience might trigger an ‘after philosophy’ reflecting anew on the relationships between the ‘first’ and the ‘second’ nature of body and its relation to the *conditio humana*. ‘After philosophy broke with the promise that it would be one with reality or at least struck just before the hour of its production, it has been compelled to ruthlessly criticize itself.’, (Adorno, Prologue and Introduction to Negative dialectics, 1966). Going back to the issue that there’s always a body performing a narrative, the question of the *self criticism* implies a question of *self-touch* – an autoerotic approach as in Erotogod where users both question their body through touching themselves as well as writing a founding narrative of the embodied self.

Is a story independent across or formed by its media (Ryan, 2004)? Does a story lose properties if various media re-tell the same story? Or does it gain something? For long a story was thought to be the same story across media (ibid, p. 1), but not so anymore. The properties of a medium influence not just *how* we tell, but also *what* we tell. Like the various affordances of the body (section 5.8) in phenomenology, the various media afford different stories and shape the narrative. Haptic touch affords a unique way of telling stories and involves the whole body. Touch undergoes a narrative transformation through the bodysuit. This demonstrates the second storytelling moment from section 5.5. of how haptic stories can be simulated. The user's self-touch produces actual textual expressions on screen. These are in turn transformed into an artistic narration composed of moving graphics, sound and tactile impression onto the body. In this way the haptic storytelling completes its sensory loop. This shows the third storytelling moment from section 5.5., presenting a haptic artistic experience. Further this can also be read as the formation of touch as a genuine artistic medium. As the next section will discuss, perhaps what is missing in order to develop a haptic storytelling -including a haptic language and vocabulary- is a domain of haptic aesthetics

6.10. SOMAESTHETICS – THE BODY AESTHETICS OF TOUCH

In haptic storytelling the body becomes so to speak the canvas for artistic expressions and experience. Developing a vocabulary and language for haptic storytelling therefore raises one important question: is there a specific aesthetics of touch, a *body aesthetics*? Richard Shusterman has proposed the idea of a body-centered discipline that he calls somaesthetics (Shusterman, 1999). It starts with Baumgarten's aesthetical project, where he coined the term aesthetics from the Greek *aisthesis*, meaning '*sensory perception*'. As we know this became a formal discipline, founded on our perception of the world and art. It is a systematic discipline of perfecting sensory cognition (ibid, p. 300).

However, Baumgarten omitted what Shusterman focuses on: the cultivation of the body and the 'soma' which, derived from somatic, literally means 'of the body'. Baumgarten never mentions factors related to physiology or physiognomy. Instead he appears to identify the body with the 'lower' senses. According to Shusterman, modern philosophy displays the same 'somatic neglect'. Philosophy's critique of the senses is historically rooted. Knowledge is largely derived from and -based on our sensory perceptions. These are subjective and unreliable; therefore they must also undergo careful study and be assessed critically. Nonetheless they represent an important focus on lived experience and its influence on self-knowledge.

This is reflected in Hume's statement that 'Beauty is no quality in things themselves; it exists merely in the mind which contemplates them' (Hume in Shusterman, 1999).

A critical issue here is the degree of freedom under which we gather and live embodied experiences. According to Michel Foucault and his notions of biopower and biopolitics, our bodies are objects of political powers that involve all aspects of life. This is problematic for a notion of a body free of external restraints, but belongs to the history of contextualizing the body in relation to all the complex factors shaping our lives and environment. Examples related to Foucault are found both in Merleau-Ponty's intentional arc and Bourdieu's *habitus* as 'structuring structures'.

Historically a somaesthetics is problematic. It relates to the fascistic and national-socialistic body philosophy which cultivated a political and instrumental view of corporeal beauty. A body aesthetics cannot escape this historical association, and must take this –as Shusterman does– into account. Beyond this critique it is worth while exploring as it promises to explain and explicate the aesthetic potentials of touch. Shusterman counters the critique of the body as raised by Horkheimer and Adorno by pointing to their own objectification of the body. Their critique of the body falls into the same trap of reducing the body to a mechanism and their gaze on the body becomes what they want to avoid: the gaze of a coffin maker (ibid, p. 305). The crucial moment here is whether the body is to be considered as an object of beauty, or as an embodied, lived experience? This is a matter of an external versus internal gaze. As Shusterman proposes it, he underlines the immediacy and the living, internalized dimension of somaesthetics. Touch is, as such, a lived, embodied experience. It is a 'dialectical sense' constructed through personal experience. The goal of a somaesthetics is to play an important role in the art of living (ibid, p. 302). Even if the percepts of the body are unreliable, they form the base of our knowledge. Somaesthetically speaking and as an intersubjective experience, haptic storytelling contributes to building, questioning and affirming bodily knowledge. As such it represents a practical somaesthetics (ibid, p. 307), a specific body practice and use of the body as living soma - aiming at somaesthetic improvement (ibid, p. 310).

Martin Jay shows in his article on 'Somaesthetics and democracy' (in Franke & Früchtel, 2003:45) how Dewey saw artistic experience as involving the whole body. If we include this stance into somaesthetics it is another argument against the historical and fatal conception of a hierarchy of the senses. The somaesthetic is concerned with understanding and explaining the multimodal perceptions of the body. The possibility of telling haptic stories represents a unique somaesthetic example. Beauty here becomes a question of embodiment.

6.11. ON AN ETHICS OF HAPTIC ART

The thematics of sensuality and religion might appear provocative to many people. It is therefore necessary to close this chapter with some remarks on the ethics of haptic art.

Ethics deal with knowing what is right or wrong. As an applied field it is also concerned with furthering our understanding of practical issues of right and wrong (Tim Dare in Chadwick, 2002:23). It is often confused with morality which is concerned with doing what is right or wrong. In everyday use ethics and moral are frequently used as two similar terms (Baggini, 2002:57). Morals can here be seen as an imperative subset of ethics, prescribing what we have to do (ibid).

Experiments and installations involving both the physical wiring of the human body and exposing them to haptic experience raise several ethical issues. One is about the physical and psychological risks of haptic stimulations. Physical harm and injuries are always a risk when one stimulates the body by mechanical means and interfaces. Possible damage involves electrocution, skin rash, damage to the skin, allergies, spastic seizures triggered by immersive and erratic touch patterns. In my *Solve et Coagula* project the patterns drawn by the full bodysuit resembled the movement of a snake or insects around on your body. Such sensations could trigger fears and anxieties. In case of sexual stimuli through dildos and anal vibrators specifically, damage could happen if penetration of the body's cavities occurs. This could also cause a sense of psychological unwellness due to doing something one thinks one should not do. Another issue is the social effect haptic experiences can exert. One participant of my *cyberSM* project told his partner he had touched someone sexually online. The partner thought he had been unfaithful, and quit the relationship. As this shows, sometimes the virtual has very real consequences.

Concerning physical harm to the body I have in all my experiments first tested the haptic effectors (output). All haptic elements and stimuli were first tested either on my body or those of the other project participants to test what functioned. In this manner we were quite confident that no one would suffer any physical damage. That was also very unlikely because of the scaled down electrical output of the electronics. All voltage connected to the body was 5 volts and maximum 0.2 amp. This is within total safety limits for the body. Additionally, guides were always present to help users not to trip and fall inside the installation.

In case of psychological damage as a consequence of haptic stimuli this is hard to foresee, but can occur in connection with sexual and religious morals. However, all participants that were dressed in the bodysuit were carefully told about functionality and the sensual dimensions of the piece. All users

should therefore have a minimum knowledge of what is to be expected in order to make a qualified decision to participate or not.

Another ethical aspect to discuss here is the possible religious apprehensions with the contents of Erotogod. The title is a combination of the words 'Erotic' and 'God'. Is this mix of the body with a notion of 'god' something that orthodox people would collectively react to? According to the questionnaires from Erotogod in Amsterdam most participants did not feel morally offended, but then again only 22% said they had a religious conviction.

Clive Cazeaux's article on *The Ethical Dimension of Aesthetic Research* (2003) raises the question that all researchers doing aesthetic practice as research are faced with: '*What must I do for my work to count as a contribution to knowledge* (ibid)? This implies taking account for not just other researchers in the field, but also to take a stance to the historical developments behind or in relation to one's own works. This is a difficult ethical demand to make since art of the Avantgarde tradition, as discussed in chapter three, strives for the highest degree of independence from both other artists and traditions. Suddenly, through research, one is faced with the fact that there is no '*l'art pour l'art*' (art for art's sake). In Hannula et al's book on 'Artistic Research', ethically aware scientific and artistic research is aware of its own starting point and goals and has a critical view towards them (Hannula, 2005:48). I have made an effort to be in accordance with this throughout the thesis. Also I have attempted to be ethical by relating my work to other projects.

My projects and experiments have all been situated within the field of art. Furthermore the aim of the projects has been to create art. They also deal with perceptual manipulations of the body and therefore possibly even the abuse of humans. However, they have not aimed at being a laboratory for psychological research with human guinea pigs. Artistic experiments are for volunteers. Visitors go to museums, galleries and exhibition areas of free will. They even tend to pay for entrance. In my tactile experiments no one have been forced to participate or paid to undergo the experience of the installations. The settings of the Erotogod installation has always been in the public domain and during exhibitions it was open and accessible to the public in well known, established and protected settings like the Henie-Onstad Kunstsenter, Atelier Nord or the DEAF festival in Rotterdam. I have therefore all reasons to assume that the participants were all willingly undergoing the experience and my experiments as well. Both the context of new and experimental media art as well as the setting within 'safe' museums, has made the participants willingly take on the risk of having a slightly different experience of 'reality'.

6.12. SUMMARY AND DISCUSSION

This chapter has first examined the practice-based making of my project Erotogod from 2001 to 2003. The project contributed to the forming of my critically-informed practice through serving as a test ground for combining critical thinking with experimental combinations of multimodal stimulations. It gives a concrete example of an empirical and practice-based research on interactive, multisensory and immersive experience within computer-mediated art.

Starting out with the historical inspirations of the project, the chapter explains the technical setup behind the visual, aural and haptic expressions. As the most important issue of this thesis is about the practical use of touch, the chapter further comments on the possibility of developing a haptic language. Such a language is fundamental to developing methods for haptic storytelling. To explore the possibilities of haptic storytelling the chapter reflects on the production of pleasure through haptic technologies. The example of Stendhal's epiphany in Florence indicates how much art can affect our emotions. As my contributions to the building of a haptic vocabulary shows, haptic stimuli put into a system and with an Optimal Tactile Resolution can produce and re-create emotions rendered physically real. In addition to the Erotogod project, the 'World Ripple' project is also an example of this. The chapter discusses the phenomenological distance between the subject and the experience that the bodysuits create. This estrangement represents a phenomenological experience of autonomy.

The listing of all 103 touch patterns that make up the haptic vocabulary of Erotogod points to the wide potential for creating new impressions of touch. The vocabulary is implemented and viewed as one conglomeration of experience in the questionnaire. The findings must therefore necessarily be of a general nature. What is suggested for future research is to study and analyse single patterns one by one as they are sensed by a reference group of users. There are definite limits to current haptic storytelling and vocabulary. Here - as for all linguistic constructions- the following paraphrasing of Wittgenstein¹¹⁵ appears correct: the limits of one's (haptic) vocabulary are not equal to the limits of one's (life-) world (Howes, 2005:1). Despite the limitations in haptic expressivity and narration, the Erotogod project demonstrates how touch can be approached as a genuine artistic medium.

The chapter introduces the notion of somaesthetics describing an aesthetics of and rooted in the body. This represents a new field of aesthetics directly related to haptic storytelling that so to speak involves the body as an artistic canvas of experience.

¹¹⁵ 'The limits of my language mean the limits of my world' (T 5.6).

Phenomenologically my works allow us to experience the artwork as embodied experience. Immersing the users in haptic impressions it also allows us to think embodiment anew. Based on the questionnaires and my observations of users of the Erotogod experiment, the next chapter consists of a case analysis of the outcomes of my practice-based art work.

7. CASE ANALYSIS OF EROTOGOD

How does one analyze an artistic project? As discussed in chapter two, such projects are known for their subjective dimensions. The same is true for Erotogod. However, as discussed in chapter two, analysis is also a matter of choosing one's approach and one's tools for the process. The following chapter will present how my choices led to their findings.

The analysis is based on the combination of personal reflection, observation of users, and evaluation of data acquired through questionnaires. It serves as the basis for the subsequent reflections and outcomes. Doing an analysis on the basis of such data is in general a complicated task and dependent upon the subjective interpretation of the researcher. An example is my use of multiple choice questions as in question 19 (see questionnaire in appendix). When questions allow multiple responses they are open for multiple interpretations. Also, one may not be sure if the respondent checked all of his or her choices or if he or she forgot to check some responses. The questionnaire used involves several scale questions. Rating these is also a matter of interpretation since factors of uncertainty are, if they appear unfamiliar to the respondent, hard to understand or even ambiguous in nature. The design of the questionnaire tried to take such uncertainties into account. One example of that was the use of a seven point scale. This was done since a three point scale is not enough because people avoid the end points. On the other end it is tricky to discriminate between more than seven point ratings.

Another important element for the interpretation of the questionnaires is the frame of the analysis i.e. under which conditions it is conducted. One element of this framing is the stated aim of this thesis (section 1.1) to focus on *touch as a tool applicable to body-based haptic systems and in particular through the use of bodysuits*. I will therefore put emphasis on the analysis of the questions involving bodysuits. Other questions that frame the analysis are the two overarching research questions at the outset of the thesis (section 1.3):

i: the general question: How does haptic, corporeal interaction influence the overall experience of a given interactive human-to-computer system?, and

ii: the specified question: What is the role of vibrotactile stimulation within multimodal, computer enabled environments?

Answering these questions is central to conducting the analysis and outcomes. The answers will be interpreted with help of Dreyfus and Dreyfus' phenomenological methodology as described in section 5.8. This is helpful in finding out which typology of 'action spaces' or affordances (*Handlungsräume*) the questions in the questionnaire belong to, i.e. biologically given through the physical constitution, ii) historically coded through the corporeal context and iii) a culturally coded. Breaking the questions down in this way can possibly lead to the formation of specific patterns important to revealing the development of meaningful use and experience of touch.

The most important guidelines to analyze the questionnaires were the following questions:

- A. To which degree and how do the action spaces -or affordances (section 5.8) - relate to the given answers?
- B. What can be changed in the future when thinking of these three dimensions?
- C. What is impossible to change (related to A)? Are there certain biological, cultural and cultural affordances that make change impossible?

Also relevant was the question if any answers indicate an ontic *breakdown*? As discussed on breakdown (Heidegger and Vygotsky in chapter five), when a particular experience of art falls apart, the art installation goes from being 'ready to hand' to being 'present at hand'. We have a breakdown experience that triggers reflection. Important for the analysis is whether any answers describe these glitches (collapses) of experience or not. If this is the case, we can expect more of the nature and significance of the Erotogod bodysuits to be revealed.

7.1.1. USER INTERVIEWS

The users of the experiment were interviewed with a questionnaire. To secure enough data the minimum size database was judged to have approximately twenty-one participants. This number was set as it seemed practically feasible

to realize. The amount of data collected should also be sufficient compared to other and similar investigations (Beryl, 1997 and Janesick, 2000:383). During the exhibition of Erotogod at the DEAF festival in Rotterdam in 2003 a total of 36 interviews were done. These form the main body of data from the experiment.

The different visitors are expected to have quite different experiences with computer-enabled environments. Any major divergence in the group's answers to the questionnaire will therefore serve as a critical measurement.

Inconsistency might also be a sign of great socio-cultural differences in the perception of interactive experiences.

The interview was structured (D. Kuhn, 1991) so that the users were first indirectly observed during their trying of the installation. The respondent was then asked to fill out a 2 ½ page long structured questionnaire with around twenty questions.

I had originally planned doing depth interview in the form of an informal, open conversation with up of five participants. This was planned to be done after the respondent has answered the questionnaires and the goal is to reveal the participants more personalized, qualitative impressions/opinions. Due to lack of time this was not possible. Observing users and collecting the questionnaires took too much time and I had to focus on that task. Also, another critical moment for depth interviews is the large amount of data generated. Transcribing a two hour interview could amount up to hundred pages. This again could simply prove to be too much data to analyse.

7.2. DESIGNING QUESTIONS AS QUALITATIVE CONTROL PARAMETERS

In designing the questions of a qualitative questionnaire one is faced with several challenges. Due to the open-ended nature of practical-aesthetical experiments, these questions must be carefully designed to assure a relevant and systematic collection of knowledge. Starting with the case of my practical experiment-design I selected several categories of interactive 'phenomena' before I wrote my specific scheme. Within immersive computer-enabled environments the three I's (Heim, 1998) have a particular important position as parameters. They signify Interactivity, Immersion and Information intensity. In the thesis the two latter parameters are relevant for the evaluation. How do the participants qualitatively experience these dimensions? A central issue in designing the questionnaire was the question about the installation's role as 'verificator': In the case of the tactile experience inside the body-suit in Erotogod: is it possible to employ multisensory and tactile experience to measure the effectiveness of embodiment? And if so, how does it differ from other interactive experiences?

7.3. QUESTIONNAIRE

My questions have evolved as an elaboration of Beryl Graham's scheme developed for her Ph.D. about interactive computer-based artworks (Graham, 1997). Her schemes of questions guided my initial attempts, but were significantly changed during my pre-interview research involving test-interviews and discussions with three volunteers. A project's hypothesis dictates both questionnaire questions and (practice-based) research methods. Corresponding to my qualitative approach and on the basis of my list of working hypotheses, the final questions focused on the user's personal experience. In the main questionnaire about the specific user experience inside the installation I developed and asked questions like:

Q: How did you experience the installation? (Please circle you answer):

A: Unpleasant No particular reaction Pleasant Very pleasant

And

Q: Did you feel that you were in control over what happened to you inside the installation?:

A: No control Little control Partial control Full control

Together with similar questions focused on the subjective user experience my intention is to gather valuable information concerning i) whether the user felt a perceptual break down situation had occurred, and ii) if it is possible to deduce such a break down situation indirectly from the answers. There are several possible sources for error in such emotional and subjective questions. One being the participants is either overwhelmed by stimuli, another their lack of understanding of the system/experience. In both cases this could lead to exaggerated and nonsensical feedback. One way to avoid this is to employ questions intending to challenge and provoke the user. One such example is:

In the future the computers will most likely be without keyboard and mouse. Do you think that the computer of the future will look like Erotogod? (circle your answer):

Yes No

By combining a statement with a question there is more 'objective' substance to work with. It sets the questions in a setting that might be easier to

understand. The answers of these questions are expected to better reveal what the subject thinks—directly—or indirectly in combination with the other answers. Also, by providing only four choices on the scale from bad-to-good there is no middle and neutral value. This design forces the participants to make a choice by answering in a negative or positive way.

7.4. USER OBSERVATION

Observing the user in a contextual situation is an important method for gathering empirical material. It does however require careful studying and execution (Denzin and Lincoln, 2000:634). Problematic issues are that all observation of the world is active. There is no neutral, objective way of seeing a thing or a subject. Even the process of just watching someone has an effect on the experimental conditions. Having this in mind I chose the following ways to observe the participants of my experiment:

- a) Direct observation: I used the technique of participatory observation. This is characterized by the planned observation of users conduct in ‘natural settings’, that is in the media-art installation. One of the common sources of errors is the change in the observer himself (Friederichs, 1990). This can be due to over focus on specific individuals or tiredness. Practically speaking, during the experiment I introduced and explained the basics of the installation to the participants in person. Then I was visibly in the same room during the whole trial of the interactive installation. However, because the installation space was darkened due to the video projections I was not easy to see.
- b) Indirect observation: each participant was recorded on video by a single digital video camera. This audiovisual data was in part later analysed and compared to the notes taken during the direct observation. Because of the videos visual accuracy of the participants behaviour it is important material serving as an error-correction method and possibly to prove the validity of my observations.

The purpose of the combination of a) and b) is to research the complex patterns of interaction, and to gather better data of the participant’s responses and expressions. Critical questions are what kind of data do we really get? When the recordings can be viewed ‘objectively’ by others, it is still imagery taken from my subjective angle. What can it therefore reveal? I apply this method of observation as offering a correctional perspective. One example could be if the participants express content during the experiment, but the

video reveals that their facial expressions are stressful, then such discrepancy renders the data in need of careful attention or in worst case useless.

7.5. PRODUCTIVE REFLECTION ON PERCEPTUAL BREAK - DOWN

One of my goals is to reflect productively on the role of disturbance in complex, perceptual systems. This procedure is open, experimental and based on a philosophical discourse where statements are used as active tools (hypothesis) to discuss the different issues at hand. The focus of the productive reflection is on the subjective experience during experimentation. A measure that I will use for this is the concept of perceptual breakdown.

What I can name cannot really prick me. The incapacity to name, however, is a good symptom of disturbance. - Barthes in *Camera Lucida*.

As Barthes notes, in an aesthetic context disturbance is a highly charged experience. The perceptual conflict between sensing something and not knowing it, is -in a platonic sense- an erotic experience. It propagates a desire to achieve that which one senses, but does not yet possess. Also Barthes suggests that this is a creative dimension. It represents a challenge to our habitual 'being in the world' (Heidegger). It is also a distinct sensation. You know when you're irritated. In this sense it also represents a qualitative measurement. An interesting perceptual test-system (art work) should be able to induce user-sensations that alternate between that of breakdown of (user) expectancy and satisfaction. This relates to the breakdown situations as described both in activity theory and phenomenology in section 5.4.5 and 5.4.6. One strategy to induce this condition is to saturate the user with multi-modal stimuli and critically measure/observe the reactions. Such saturation of the senses represents a unique research strategy of this thesis. Another goal of this process is to discover the limits of technology by going over the (perceptual) extremes. The installation *Erotogod* was made to provoke such break down scenarios. The methods I have used attempt to reveal such cases – and whether they happen. The questionnaire was formed in a manner suitable to reveal this. Combined with user observation it should clearly show whether perceptual breakdown happened or not.

This pluralistic combination of the mentioned research methods in chapter two is what can be described as a 'hybrid' methodology.

7.6. QUESTIONNAIRE AND GENERAL FINDINGS

The 36 questionnaires analyzed below are the answers from the users of the *Erotogod* installation in Rotterdam. The outcome appears as a fairly reliable

source of data despite the mentioned problems with evaluating questionnaires. The full questionnaire and detailed answers are attached in the appendix. An example question with the table of findings is below:

Question 8i The Bodysuit was:

Code	Value	Frequency	Percent
1	Good	13	35 %
2		14	38 %
3		6	16 %
4		2	5 %
5		1	3 %
6	Bad	0	0 %
7		0	0 %
Total		36	97 %

Figure 7-1 Table of the findings from question number 8i in the Rotterdam questionnaire.

Most participants answered all questions. Since the questionnaire has a deep qualitative dimension, the answers must be analyzed with the subjective dimension of the researcher's interpretation in mind. Below is a general summary of the most important findings. Most participants:

- Are in the age group between 20 and 30, and own several consumer technologies like walkman, mobile phone and pc. 78% also use computers daily.
- Are men (57%).
- (65%) go regularly to art exhibitions.
- Have not tried similar installations (70%).

Most participants also found the installation:

- Challenging rather than simple.
- Dynamic rather than static.
- Exciting rather than boring.
- Pleasant rather than unpleasant.
- Dreamlike rather than real.
- Meaningful rather than pointless.
- Found the sound dynamic rather than static.
- Thought the bodysuit was good rather than bad.
- Found the bodysuit exciting rather than boring.
- Thought the bodysuit influenced them very much in a positive way.

- Found they had some or good control of the installation, sound, projections and interactivity.
- Had a fascinating rather than ordinary experience.
- Thought it was erotic rather than mechanized.
- Thought the installation was interesting and interactive rather than dull and static.
- Most participants did not feel observed.
- Most people (78%) felt they spent a shorter time (5 minutes) inside the installation than they actually did. The time spent per person in interactive mode was 7 minutes plus the time it took to dress and undress.
- 81% would like to try it again.

In general the answers indicate a very positive experience of the Erotogod installation. What the users experienced was also much in line with what was intended, namely creating a new and immersive and different experience of one's body. As an artistic work the project can therefore be said to have had a certain degree of success.

However, what do these responses tell when evaluating what the project did? Even more importantly, what is their answer about what touch can do for similar projects in the future?

7.7. ANALYSIS AND REFLECTION ON SPECIFIC RESEARCH QUESTIONS

At the start of the thesis four research questions, each with a specific hypothesis, were asked. Each one will be treated separately in this section.

7.7.1. Question 1 on immersion:

Based on how users seemingly lose themselves in haptic, immersive installations, the first question asked if haptic stimuli contribute to the sense of immersion. If this is the case what new qualities does the tactile stimulation in interactive environments represent?

Based on participatory observation of the users of Erotogod and the answers of the questionnaires the following was found to be of significance to the first question:

- Observation showed that most users appeared much focused on what happened inside the installation. This was despite the fact that they were relatively exposed to the public gaze. The audience could see the participant from behind and through several larger gaps in the projections screens surrounding the participants. As most users observed others since all had to stand and wait in line before trying the installation, they must

also have been aware of this. The answers of the questionnaire revealed however that most did not feel observed. All together these observations indicate that the installation captured the user into an immersive experience. As most participants had not tried similar installations before, it could be that both their high focus and the high sense of immersion came from the curiosity of trying something for the first time. However, as most users use computers, modern communication and visual technologies on a daily basis, a larger indifference to the visual and aural elements could have been expected as well. Since this did not happen, and because the majority found the bodysuit exciting and good rather than not, this is a strong indication that the use of haptic stimuli did make a difference for the audience reception. This finding is considered a contribution of the thesis.

- The expressions of the text, visuals and sound were fairly abstract. Few reported to have been able to read the main projection on the front screen as anything else than moving visual elements. Even without reading the accompanying text, the participants still point out that they found the installation meaningful rather than pointless. Observation confirmed that users became very focused inside the bodysuit, and both of these findings give a positive answer to the first hypothesis, namely that the use of a bodysuit strengthens the sense of immersion and experience when inside an unfamiliar and media-based environment.
- Related to which new elements the haptic dimension introduces, this is a relatively problematic question to answer precisely as the questionnaire was slightly unspecific. The form of the questionnaire was on a more general than specific level concerning the experience of touch. However, the very positive reaction to the installation indicates that users felt the experience to be personal, intimate and of significance. Again, considering the high level of abstract expressions, this could just as well have been the opposite. So why was did most users feel rather positive inside? During observation I found that many people looked highly focused on the screen while touching themselves. But did they feel a connection between how they touched themselves and the results on the screen?

The answers to questions 15 and 16 show that most users felt that they could both influence and control the situation. At the same time relatively few felt in total control. This could be interpreted as a hint towards break-down situations. Relating to Kant's notion of autonomy (as described in section on haptic pleasure design), it could be that the participants felt that the

strangeness and ‘otherness’ of the installation became somehow pleasant, once it was experienced. If some kind of break-down occurred, when did it happen? From a dramaturgical point of view the Erotogod experience was coded (see figure 6-6 on the installation’s dramaturgy) so that the users more or less had to lose control in the last minute of the seven minutes long duration. They could still influence parts, but too many parameters in sound, visuals and touch changed for them to experience full control.

If a break-down occurred related to the external media, that is sound and visuals, one could expect users to retract to a heightened awareness of and/or focus on their inner bodily condition. Such a reflection is indicated in the answers of question 8. Most users answered here positively on their experience, but positivity is not the most interesting aspect in finding the occurrence of a possible break-down situation. What is interesting is not whether users find it good or bad, but that most answers leant towards one end of the scale.

This indicates that most users had a similar and clear sensation of a specific corporeal experience and points further to an ‘inner’ reflection on the corporeal condition that can be interpreted as both the occurrence and the consequence of a break-down situation.

7.7.2. Question 2 on sensory resolution:

The second question relates to the observation that users of haptic installations appear to be more perceptually ‘puzzled’ than in audio-visual only installations. Is this because of how the number of sensory channels and their resolution influence on perceptual experience? And if, could this have a close correspondence to the design of the bodysuit? Based on my observations and the questionnaire the following interpretation could be made:

- The answers of questions 6ii and 6iv show that most users find the installation dynamic and pleasant. Together with the other answers that emphasize positive experiences this seems to confirm that the addition of an extra sensory dimension -that is the haptic- adds to the richness in experience of sound and vision. This contributes also to the explanation of why users appear more puzzled. However, what if it was the result of a ‘sensory overload’, that is that too many things happen at once for the user to ‘digest’ the sensory impressions? If this was the case, more negative answers would have been likely to have been found. As the next paragraph shows, this was not the case.
- The answers to question 11 about the overall evaluation of the experience and question 14 about the bodysuit point to an interesting

experience in relation to the bodysuit. The functionality of the suit was programmed to have some very intense phases of output to the body. This was done in relation to the non-interactive passages of dramaturgy of the installation. I expected more users to have felt these phases as haptically too intense. Instead the opposite seem to have occurred. This is a quantitative indication that the number of sensory channels can easily be expanded without the user suffering overload. At the same time this is also a matter of qualitative coding of haptic expressions. There exists too little data both from this and other experiments to evaluate how this can be done better, which opens up an interesting field for future studies.

- The clear and positive answers to question 14 about the bodysuit seen in relation to the answers of the more general response question 19 indicates that the haptic design of the bodysuit was successful in terms of user experience. Immersing users in haptic patterns that practically speaking covers the full-body seems to add to the overall sense of immersion. A critical remark here is that there was no time to experiment with less vibrotactile outputs. Then again, these results confirm my observations of users of Erotogod relatively to the sense:less installation (1996). The sense:less suit had only 16 outputs. To my observation this was too little to give the users a convincing sense of corporeal immersion. That observation was confirmed by the user response in Erotogod and indicates that a minimum resolution of a vibrotactile bodysuit must be somewhere between 16 and 90 zones distributed evenly around on the user's body. This finding is considered a contribution of the thesis.

7.7.3. Question 3 on the real virtual sensation

The third question was based on observations of users responding as if they sensed and felt something (movement, push/pull) that was not really there. Did the haptic elements of the installation influence the perception of the users in a direction of making the virtual experience more real? Based on my observations and the evaluation of the questionnaire the following was found:

- Qualitatively most users reported they felt well. In question 19 users generally find the installation both 'sensual' and 'pleasant'. None of the qualitatively weighted answers indicated that users felt pain or that the experience was unpleasant. These results can be seen as a sign of the user's high level of awareness of bodily sensation. Phenomenologically it appears as if the bodysuit 'grounds' the user to the installation in the sense that users appear to feel themselves as a corporeal and integrated part of the spectacle (story). The haptic experience appears to make the installation a transparent element in the 'Lifeworld' of the users. On the other hand it is not easy to deduce general answers to the question how

the installation specifically influenced the perception of the users, one can speak here of idiosyncratic rather than universal aspects, of which the former are nevertheless able to show tendencies in experiences of immersive media art.

Further, the situation under which the users experienced vibrotactile patterns was too unspecific to make unambiguous sense of the feedback. There was neither practical problem solving involved nor linear navigation through 3D spaces. If the users, for example, had had to navigate a virtual model of a building one could easily have observed and measured change of patterns of movement as a consequence to haptic events. Such observation could lead to change in practical design which again could influence real-life navigational behaviour. Neither the experience nor the questionnaire used in *Erotogod* is specific enough on such issues to deduce precise results, but the following scenario indicates an interesting case study for the future: how does haptics influence, for example, architectural-based design problems of how to navigate through virtual buildings? In such a scenario one could systematically control the haptic stimuli and hence form a good impression of reproducible haptic perception (Grunwald, 2008:365). In line with the findings from *Erotogod* it is likely to expect that a good design of haptic stimuli will influence the users positively and that they might feel the experience to be more real in the sense of realistically modelling real-life experience that is not expanded through media.

- Whereas fewer of the respondents of question 6vi had a clear opinion of how meaningful the installation was, none found it pointless. Many found their experience and feelings ‘theatrical’ (Question 19), but most reported them to be sensual and pleasant. This indicates an artistic—and therefore perhaps abstract—but dominantly strong emotional experience. Such experience can be understood as being more ‘real’ in the sense that it affected the user intimately. Also 81% of the users wanted to try the installation again (Question 31). This can be interpreted as if they felt convinced that the installation was meaningful and therefore ‘real’ to them.
- Question 8ii gave unclear answers in relation to whether users found the bodysuit ‘human’ or ‘mechanical’. The answers given are in this case dependent upon how the recipient understands the question. In relation to the strange ambience of the installation it could well be that users would interpret stimuli towards a ‘mechanical’ expression, whatever value they might put into that. Also the vibrators were so powerful that they at times emitted a high pitch sound as if they were small engines—which in fact they are. Still many found the bodysuit ‘human’. This indicates both that

they were comforted by the touching patterns produced and that they did not mind that it was exerted by a machine. These answers can again be an expression of an anthropomorphic attitude where the users put their wish for the installation to be meaningful ahead of a more analytical and critical, Turing-test like attitude (Chapter one and Moor, 2003:37).

In sum, the answer to the third research question is that haptic elements influence user's perception of a given media-based experience in the direction of making it appear lifelike and 'real'.

7.7.4. Question 4: the possibility of haptic expressions

The fourth and final question bases itself on the similarity in user reactions. If users experience similar sensations, is this then an indication of an intersubjective experiential haptic vocabulary? Based on my observations and the questionnaire the following was found:

- The responses to the questions directly about the bodysuit, questions 8 and 14, indicate a high degree of involvement and engagement. Most users reported their experience to be fascinating (Q11i) and being inside a bodysuit they found exciting (Q8iv). Such a uniform response indicates that the design of haptic patterns must have been fairly understandable for most participants. This can be read as a clear indication of the existence of an intersubjectively understanding of touch. Seen through the corporeal optics of Dreyfus & Dreyfus this can be explained because the users i) have biologically the same bodies that are inclined to sense the patterns of touch as the designer, a 34 year old Swiss female. Secondly ii) because they have historically learned to deal with corporeal touch and thirdly iii) because the primarily western European users of Erotogod have a cultural upbringing that expressively codes the way intimate touches are understood. Testing the historical and cultural understanding of the project could be done if participants from different ethnicities and in different parts of the world took part. If this was to happen a more exact categorization of responses could have been done. This is beyond the scope of this thesis, but could be of interest for future research both on biological, historical and cultural discourses on the perception of touch. With the Dreyfusian perspective in mind it is reasonable to conclude that the users' perceptions of the installation are so uniform because this is i) biologically given through the similar physical constitution of the human participants, ii) historically coded in the users corporeal context and iii) a culturally likely interpretation due to the relatively homogenous group of participants (Questions 2, 4 and 29). This again is a strong indication of the likeliness of the existence of an intersubjectively understandable

vocabulary of touch and confirms my artistic experience during my many installations using vibrotactile stimuli. However, a formal first version of a haptic vocabulary is yet to be completed. This is an interesting challenge for future developments.

7.8. REFLECTIONS

The findings of this qualitative interpretation leave a positive impression concerning the use and potential for haptic stimuli. A critical element that needs careful consideration is the strong qualitative dimension of this evaluation. How can the results be trusted when the artist himself evaluates his own project? Indeed, the findings are open to different interpretations, but the answers to the questionnaire give fairly clear indications of which directions the users' experience of the sensations and feelings go.

In chapter five I stated that my artistic interest is in finding out how new combinations of multisensory perception can assemble creative acts in that they *measurably affect the structure of our consciousness*. Can this be said to have happened in Erotogod? The strong corporeal dimension of the users' experience indicates that the installation did have an impact on how they reflected through their bodies. Phenomenologically speaking, the corporeal affect appears to have resulted in corporeal thinking. Such a finding could be seen as a documented perceptual effect of an artistic work. This again relates to the question of artistic research and methodology as posed in chapter two.

As put forward in chapter four, another relevant questions to reflect upon is how much of the body is needed to be covered by haptic stimuli in order to sense full haptic immersion?

The suit of Erotogod covers upper body including parts of the back, the full groin and parts of the buttock, the upper part of the legs as well as lower arms. The answers of the questionnaire indicate that this is sufficient to sense full Haptic immersion. The question relative to issues such as Penfield's theory of body maps asks which areas of the body are more important than others to cover. The Erotogod suit does not cover the larger area on a Penfield's map such as the highly sensitive lips and hands. For the user response this does not seem to make much difference in finding the sensations felt to be pleasant and good. This could be an indication that i) does not matter where the body is stimulated as long as the resolution is high enough (see discussion on sensory resolution) or ii) parts of the body is included, like the autoerotic touch of the hands necessary to make the suit function, in such a way that the corporeal stimulation of areas of lesser sensitivity is 'transpositioned' and felt as if they were sufficient.

It is interesting to look at deviations from the general findings. One of the five users (number 59) who did not want to try the installation again, said he did not find the work interactive enough. At the same time he found the work

sensual, strange as well as pleasant. Concerning the bodysuit it was rated more towards good than bad (Q8i) and got almost top score for being exciting rather than boring (Q8iv). There is reason to believe the user took the questionnaire seriously since he both filled out all questions as well as leaving a written comment. Even if this respondent tended to be negative to certain issues of the questionnaire, he still remained overall positive towards his experience. Then again, this could be due to the design of the questionnaire and that it did not facilitate for more critical opinions to come through. It did however try to incorporate a neutral and open ended form. This issue underlines the importance of continuously redesigning questions to enable all forms of feedback.

As mentioned in section 3.3.1, human subjects tend to take an anthropocentric attitude and fill in the ‘existential’ gaps and make experiences meaningful – even if they not always are (Heijmans & Van Selm in Renckstorf, 2004:301). This has been a critical filter for my evaluation of the questionnaires and has been considered in relation to the ‘positiveness’ of the responses. However, other control questions related to technology and functionality should correct for some of this tendency.

An issue that remains to be discussed, but cannot be covered extensively in this thesis is what this phenomenological experimentation contributes to a psychology of perception.

7.9. OUTCOMES

The intended outcomes of this thesis have primarily been to better explain how the use of touch can contribute to the construction of meaningful impressions. The results of the observation and the questionnaire are clearly indicative that the use of a bodysuit covering larger parts of the body has a measurable effect on users’ corporeal perception. Other outcomes of this analysis can:

- Help artists and designers use touch more effectively.
- Make it clear what can be gained from using touch.
- Help artists to design works involving touch more effectively by acting as a template for them.
- Help artists and designers select the appropriate strategies for applying touch as an aesthetic tool.
- Help artists and designers more precisely to express what a particular touching project is designed to achieve.
- Assist in creating the context of systems using touch.
- Ensure that appropriate strategies are employed when designing touch systems.

The question of an ontic breakdown has been of great phenomenological interest here. The answers give an indication of this, but must be further investigated.

7.10. SUMMARY AND DISCUSSION

This chapter analyzes, reflects and discusses the outcomes of my practice-based art work based on the questionnaires and my direct and indirect observations of users during the Erotogod experiment in Rotterdam 2003. The summary presents the findings through formal analysis of the questionnaires. These findings are positive overall and demonstrate a heightened user experience and increased awareness of corporeal phenomena. This also answers the initially raised general question of how the haptic elements influence the experience of the Erotogod installation. The specified question as to which role the vibrotactile stimulation plays is answered indirectly. Despite the mechanical construction and sounds emitted from the vibrators the users' responses indicate overall impressions of sensual and pleasant stimuli. A more direct investigation of responses to specific uses of vibrotactile stimulation is necessary to develop an instrumental use of it. This points to interesting challenges for future research, but is not at the centre of this mainly aesthetically-oriented research.

The analysis conducted in relation to question 4 on haptic expressions indicates the existence of a possible haptic vocabulary that is intersubjectively understandable. This is, however, a complex issue involving sets of biological, historical and cultural discourses (Dreyfus & Dreyfus).

In the answers to the questionnaire there are also indications of the occurrence of ontic break-down. This answers the question raised in the theory chapter: In the case when an ontic, that is particular, experience of art falls apart, the art installation goes from being 'ready to hand' to being 'present at hand'. This marks the occurrence of a breakdown experience that can trigger reflection. The findings documented here indicate how these glitches (collapses) of experience have happened, revealing the significance of the use of vibrotactile touch.

Possible negative moments of the analysis is the question of how the questionnaire could, or perhaps should have changed during the interviews. This did not happen due to the short timeframe of the exhibition. Unfortunately it was not possible to make any in-depth interviews due to the heavy workload of both running the installation and doing the research process of observing and questioning users through questionnaires. Such interviews could have clarified certain aspects and would have been helpful in the analysis. Especially the dimensions and degrees of pleasure experienced could possibly have been mapped better. However, despite the relatively few questionnaires analyzed here the findings indicate a clear

direction in users' responses and can as such be seen as a valid basis for a qualitative judgement of the Erotogod experiment.

The next chapter presents a summary of findings, concludes the thesis and looks at future applications of touch within the context of media art and design.

8. SUMMARY, CONCLUSIONS AND FUTURE WORK

Throughout this thesis my approach to touch has been from the position of a practicing artist. Within this context, touch has been a tool for experience. Touch is not about exclusive and extraordinary sensations, but – linked to Husserl’s notion of Lifeworld and Merleau-Ponty’s intentional arc - a matter of everyday experience in daily situations within the sphere of normally functioning bodies. Therefore my artistic works have focused on the technological rather than the ideological manipulation of touch (section 3.4.1).

Writing this thesis has not been a linear process, but an iterative one. It has taken many years and several re-writings to finish it in the present form. This can also be read as indication of how much information the field of haptics encompasses. The field is new, but as a response to cultural demands of attaching computing and computing applications to everyday activities, it is increasing rapidly within the communities of ergonomics and haptics. Despite a growing range of installations using haptic expression, touch is still a liminal issue within the art field. Therefore this thesis also presents a foundational work. As is often the case with scientific investigations, more questions than answers are produced, such as: Which further avenues of interest does my work create? What are the obvious ways in which this work could be elaborated upon by others? What are the practical implications of my work?

This chapter will first shortly summarize the content of each chapter. Secondly it will present the conclusions and the most important findings of this thesis. Three of the main achievements are:

- The thesis contributes to investigations of the use of touch in the context of computer-based media and artistic installations.
- The findings of this thesis indicate the likeliness of the existence of an intersubjectively understandable vocabulary of touch. It should therefore be possible to assemble a haptic language.

- The thesis has investigated the phenomenology of touch in the context of art, thereby elucidating the complexity of the experience of touch. One contribution to the field of touch in art is the construction of experiences that link mental expectations and experiences to the actual physical environment.

8.1. SUMMARY OF THE THESIS

Chapter one to seven attempted to describe the route my research has followed.

Chapter one introduced the research questions and aims of the investigation. It also framed them in relation to my professional background as an artist and my earlier work on perceptual manipulations through art. Seen in relation to the artistic works of Kapoor and Turrell, art is a field where the senses can be used to generate new impressions and feelings. Historically my approach is related to the techno-cultural developments that started in the 1960s. At the same time my research has aimed at producing some new visions for the future, where body-based media are becoming a central issue.

Chapter two is divided into two parts. The first frames the questions of methodology and knowledge production within the current debate about practice-based research. It seeks to ask some important and relevant questions about the relation between art and research as well as the nature of the knowledge generated by artistic research. The differences between art practice-in-itself and art practice-as-research are also discussed. The second part of the chapter is a route map of the methods that I applied during my practical art experiment 'Erotogod'. This chapter presents how my practical art work becomes 'art-as-research'. The methods discussed and chosen were i) empirical practice-based research, ii) user interviews and iii) user observation. These methods were applied as tools to systematically create knowledge relevant for the making disciplines.

Chapter three asks simply how touch functions. Touch in itself is an unspecific sense. The chapter is therefore dedicated to the description and discussion of the various physiological and psychological functionalities and mechanisms underlying the sensation of touch. Haptic sensations arise due to complex, interrelated chains of events set against a phenomenologically and culturally-coloured background. Early historical concepts of touch were presented through Aristotle's division of perception into the five senses. Such a division of the senses however does not do justice to the cross- and multimodal functionalities of the body. As the chapter shows, the number of senses recognized as such range from two to more than twenty, depending on how they are categorized. The contemporary understanding of the haptic sense is not as one sense, but as a result of a large network of neural and

cognitive processes. Another focus of this chapter is on the experience of touch through the combination of physiological and psychological constituents. Further it investigated how the resulting psychophysical constitution of touch relates to the phenomenological experience of touch. In a phenomenological context the study of our embodied experience of touch is at the centre.

Chapter four presents an overview of the media art field. Starting with historical research into touch and touching technologies, the chapter frames the field of digital media art that I am working within. It describes and discusses my earlier projects like cyberSM and Solve et Coagula. It presents chronologically the process that led to the development of the Erotogod experiment. The chapter elaborates on the design of the first bodysuits, which was the interface that led me to my current research and results in the field of haptic technologies. Through my observation of users in my first bodysuits I discovered what is described in chapter one as ‘wicked problems’. These appeared in my works through the combination of art and technology into an interface put right onto the skin. The result led to my initial discovery of the (practical) problems as well as the advantages of haptic stimulation.

Chapter five presents a theoretical framework for understanding embodied experiences. Embodiment is here investigated in the context of the interactive art experience. Starting with Cartesian dualism, alternative models of perception like Uexküll’s subject-oriented biology and Skramlik’s concept of haptic space is presented, the chapter broadly discusses a phenomenological approach to perception and touch. Phenomenology is presented from its early development with Brentano onward to Merleau-Ponty’s theories on embodiment. In phenomenology intentionality is a form of being-in-the-world, and the field as such recognizes the importance of embodied action for shaping perception and forming meaning. This approach is particularly suitable to describe haptic media-art experiences. A core issue introduced here is the notion of a ‘break-down’ experience. In such situations, as the famous hammer example by Heidegger shows, an object—or situation—goes from being engaged, active and ready-to-hand to becoming broken down, disengaged and present-at-hand. Through this phenomenological approach and the discussion of affordances in particular, the chapter suggests a practical tool for analysing a user’s reactions and for understanding the reactions to touch.

Chapter six describes and analyses in detail my main artistic experiment, the Erotogod project from 2001 to 2003. The chapter gives a concrete example of an empirical and practice-based research on interactive, multisensory and immersive experience within computer mediated art. Starting with the historical inspirations of the project, the chapter explains the technical setup behind the visual, aural and haptic expressions. The making

of art is not just about the end product. It is a very practical job involving a long range of considerations and elements that must come together. The chapter therefore explains also some practical concerns such as financial and ethical issues. Since the most important issue of this thesis is about the practical use of touch, the chapter further comments on the possibility of developing a haptic language. Such a language is fundamental to developing methods for *haptic storytelling*. To investigate the effectiveness of haptic storytelling the chapter ends with a reflection on the production of pleasure through haptic technologies. The example of Stendhal's epiphany in Florence shows how much art can affect our emotions. My latest 'World Ripple' project is a further example of how a systematic use of haptic stimuli can produce and reproduce some basic emotions. The chapter ends with a phenomenological reflection that emphasizes the distance between the subject and the experience that the bodysuits create. This estrangement represents a phenomenological experience of autonomy. From an aesthetic point of view, autonomy here arises in the interplay between the senses (*Sinnlichkeit*)(sensuality) and reason (*Vernunft*)(Keitsch, 2002:141). All in all, this chapter presents how touch can be used as a genuine artistic medium.

Chapter seven is the case analysis of the Erotogod project. The questionnaires are analysed and discussed and the results are summarized. Reflections and outcomes based on my interpretation and analysis of the users' experience are presented according to the four initial research questions asked at the onset of the thesis in chapter one. First of all, the questionnaires indicate that the users thought the bodysuit and its haptic stimuli did make a difference for their experience. Secondly, it was found that the number of vibro-tactile, sensory channels do influence the experience of corporeal immersion. Thirdly, it appears that haptic stimuli do make users feel experiences as more real. Lastly, the answers indicate that at least several of the users had corresponding sensations. This is an indication of the existence of an intersubjectively and experiential haptic vocabulary across cultural and ethnic differences.

8.2. CONCLUSIONS

The following conclusions add to the reflections in chapter seven and are all based on an evaluation of the findings presented throughout the thesis. The conclusions are presented sequentially according to the research route. Drawing conclusions is largely a subjective exercise. However, multiple approaches and the methods used in this thesis can provide convergent support (Mitchell, 1997:182). Besides being qualified opinions, the conclusions of this thesis can thus be read as clear indicators of tendencies.

Two overarching questions were raised in chapter one (section 1.3). First of all, the general question about how haptic, corporeal interactions influence

the overall experience of a given interactive human-to-computer system. Secondly, the specific question about the role vibrotactile stimulation plays within multimodal, computer enabled environments?

In general, the discussion of the practical art installations throughout this thesis, and particularly in chapters four and six, has shown that users show significant differences when they experience art installations that literally touch them. As Paterson notes (2007) and as the *Telematic Dreaming* installation illustrates, visual simulations of touch can in themselves certainly make users feel they are being touched for real. However, being touched *physically* for real is adding moments of real environmental influence and possibly even danger that users cannot escape. Such adaption to haptic expression leads to a heightened sensation of the art object or experience feeling real.

The particular question about the role of vibro-tactile stimulation is answered through the work with the Erotogod installation. The interviews show clearly that the vibrotactile stimulation of the bodysuit influenced the users positively in the sense that they experienced something close and proximate. Due to the complex factors influencing touch, such as culture and differences in biology, it is hard - if not impossible - to evaluate exactly what users experience.

One main epistemological aim of this research was to develop a conceptual framework for the understanding of haptic stimuli and communication. That was targeted in chapter two to six. Here various physiological, psychological, cultural and theoretical issues have been exposed and discussed. In connection with the documentation of various practice-based experiments, the thesis has, I hope, demonstrated the wide range of factors and elements influencing the domain of haptic and applied touch. The charting of all these elements portrays the complexity of knowledge domains influencing the field. Again, the notion of the intentional arc is an adequate concept to describe the complexity framing the haptic field.

My specific aim has been to present the use of bodysuits as a tool for touch in connection to body-based haptic systems. The bodysuit of Erotogod functions as a two-way tactile display, conveying vibrotactile feedback to the body and interfacing the human to the computer through touch.

8.2.1. Establishing interdisciplinary discourse

The aim of developing a vocabulary of touch across disciplines and expressions has been a recurring theme. It is practically impossible to fully develop this within the limits of this thesis. Therefore it has been my intention to prepare the ground for future development. As an epistemological framework it has been a goal to establish a better

interdisciplinary discourse of how touch affects multimodal, interactive media works. This has been done by:

- Investigating how haptic stimuli influence the experience of multimodal, computer-constructed environments. The examples presented and discussed in chapter three, four and six demonstrate how haptic stimuli can be usefully applied within art and media-based expressions.
- Identifying dimensions of haptic experience through presentation of the various touch modalities in chapter three to four and discussing them in chapter four and six.
- Investigating haptic input and output that affect the experience of interactivity has been done through the examples of cyberSM, sense:less, SeC and Erotogod in chapter four and six.
- Investigating how human emotions and reactions can be measured was discussed in chapter three, four and six and analysed in chapter seven. Within the limits of the questionnaire and the number of participants, this revealed a clear correlation between haptic impression and sense of experience.
- Understanding and modelling users' emotional experiences was done in the Erotogod experiment in chapter six. The findings show that haptic stimulation through vibrotactile technologies does influence emotional experiences. However, it is still unclear exactly how and to what degree. One reason for this is given in chapter three with the discussion of the impossibility of two users exchanging exactly the same feelings. Due to the wide number of individual differences, ranging from biological to cultural, there is a high probability that haptic communication – as all communication - will always be approximate, but never exact.

8.2.2. Research activities

To reach the goals set out at the onset of the thesis, I have conducted several research activities. Presentations and analyses of theoretical and empirical studies of interactive and touch-based media art have been done to demonstrate the effects of haptic stimuli on the user experience. My research steps throughout the thesis have included:

- Examination and assessment of the scope of research appropriate to art practice in chapter two.
- Investigation and assessment of practical art experiments as a part of my methodology in chapters four and six.

- Development of experimental art practice through the Erotogod and World Ripple project.
- Examination of interface development through practice-based research of the same projects.
- Collection and assessment of the output from the Erotogod questionnaires.

8.2.3. Answering the research questions

The answers to the four research questions asked in chapter one can be regarded as criteria for the evaluation of whether this research has achieved its goals and has produced knowledge through the interpretation of the data. Through the discussion in the various chapters and the data analysed in chapter seven, I found the following answers:

- Research question *one*, on perceptual symbiosis, asked if haptic stimuli contributes significantly to the sense of immersion. The answer to this is positive. The research shows that haptic experiences add to the user's qualitative experience. The objective behind this research question was to develop an understanding of combinations based on touch. The practice-based artwork Erotogod shows how this can be done.
- Research question *two*, on sensory resolution, asked if a higher sensory resolution adds to how the immersive and 'real' tactile fidelity is perceived (chapter one and six). The users gave an overall positive response to the use of the bodysuit. A high degree of user approval of the project was also observed. One answer is therefore that a higher sensory resolution adds to the sense of being immersed in a somewhat physically 'real' virtual world. A close correspondence between the level of sensory resolution and tactile fidelity is to be expected. However, this needs more research since a possible contra indication is found in how low fidelity applications - as the one piece vibrator in mobile phones - can convey sophisticated sensations.
- Research question *three*, on 'real' virtual sensation, asks if multimodal, multisensory experiences – like mixing sound, image and touch – contributes to the blurring of the distinction between the virtual and the physical reality. One direct control question posited was if users did feel the virtual dimension to be 'real'? Most of the users found the installation more dreamlike than real, and the answers of all point in the direction of having been intensively engaged in an experience they felt were 'real'. For that reason the answer is in the affirmative. Haptic stimuli in general and

vibrotactile stimuli in particular, can have the effect of making the virtual appear more real. I realized my aim of constructing a multimodal interactive installation to test this. Within the dramaturgical staging it was also experimented with varying degrees of sensory resolution. This has led me closer to my objective of developing improved ways of telling haptic stories of which the World Ripple experiment is one.

- The *fourth* research question, on the possibility of haptic expressions that describe general expressions (like Braille and Tadoma), is positively confirmed through the analysis in chapter seven. The hypothesis that followed was that haptic expressions can be generalized and transferred to other contexts to trigger similar experience. While this is theoretically an ambivalent question, the possibility was confirmed by the users of the Erotogod installation. Most users appear to have had similar experiences. However, it was practically outside the limits of this research to develop a formal and general technique that can be used in other contexts and projects. This could be a topic for future research.

8.2.4. Other conclusions:

This section will attempt to summarize other moments discussed throughout the thesis.

In chapter three psychotechnology and psychophysical induction technologies were discussed. Did their application influence the vibrotactile patterns felt? And did they contribute to specific and repeatable sensations or not? The overall positive response indicates also here that the users somehow were captured by the looks and feel of the installation. From here, a general conclusion is that a psychophysical design of the environment influences the users' experiences. This, however, needs a more specific investigation to be substantiated satisfactorily. As mentioned at the beginning of the chapter, one contribution of my research is my attempts to construct experiences that link mental expectations and experiences to the actual physical environment.

By the psychophysical approach of the installations, the thesis contributes to investigations of what happens to human perception when strength and loudness of a stimulus is increased (Weber-Fechner law, section 3.3.4). It also comments on manipulation of perception and how it changes when different stimuli are combined at different strengths and in unfamiliar combinations.

One of the theoretical turning points and methodological criteria was to look for indications of perceptual breakdown situations. In the case when a particular experience of art falls apart, the art installation goes from being 'ready to hand' to being 'present at hand'. This is what signifies a breakdown

experience that in turn may trigger reflections. The research had as one of its epistemological intentions to observe and describe how these glitches (collapses) of experience reveal more of the nature and significance of the use of vibrotactile touch. My indirect observation of the users, as well as the analysis of the questionnaires in chapter seven, indicates that this happened. A conclusion is that such situations can prove to be both functional tools for the analysis of perception and communicative entries to trigger discussion of art and experience.

One hypothesis, presented in chapter one and discussed in chapter five on theory, asks if it is relevant for the construction of haptic stimuli and bodysuits that the legs or the back need less direct physical stimulation than the lips. This hypothesis is derived from Penfield's body maps on sensory and motor capacity. In terms of tactile fidelity it is my experience that the more sensitive areas of the body that correspond to Penfield's map, give a heightened sense of tactile stimulation. As touch, however, is such a complex phenomenon involving several cultural elements, it could just as well be that a given culture adds a special and specific value to –for example- the touching of the legs. Also, following the example of Sandy Stone, we can transpose sensations and sensitivities onto different areas of the body. The sensitivity of areas on the body therefore appears to be trainable both cognitively and perhaps even neurologically. This is a hypothesis relevant for future research. Therefore a phenomenological breakdown situation due to haptic stimuli might appear anywhere on the body, and perhaps even in areas with lesser touch, but with a heightened culturally dependent sensitivity.

The general question of how a vocabulary of touch can contribute to haptic storytelling has been positively confirmed, but can be better specified through additions of specific data and descriptions.

In the section on corporeal affordance in chapter five the following questions were raised:

- To which degree do condition, affordance and cultural understanding relate to each other in Erotogod? The answer to this is that they come together to a high degree. This corresponds to Merleau-Ponty's notion of the intentional arc.
- What should be changed in the future judging from i) user comments, ii) technical feedback, iii) issues derived from cultural situations? The answers to this are i) that user comments were too positive (!) to drastically change the overall set up, ii) the bodysuit functions well and contributes to the experience, and iii) since the cultural background of the users was so similar, it appears as a challenge to future research to test the arrangement within different cultural contexts. More research on how culture influences body

perception and experiences and – in return - if these applications can influence society would be interesting in this context.

- What is impossible to change (corporeal, affordance and cultural background)? The answer to this is that certain neurological modes of the body remain constant, such as the mechanical functionality of the movement of the limbs and various mechanoreceptors, but that very few things appear as unchangeable in relation to how we perceive things. Our perception has a constitution that is similar to the nature of touch: it is adaptable and autodynamically reacting to external influences.

In chapter six *sensory resolution* was discussed through the question if the bodysuits in the experiments had achieved an optimal tactile resolution (OTR). Analysing the answers of the questionnaires in chapter seven the answer to this is in the affirmative. Qualitatively, the bodysuit appears to have given users a sensation of good and full body immersion. However, the feedback is too unspecific to conclude to which degree. More research is needed to answer this question adequately.

In chapter six, section 6.8 on haptic pleasure design, I posed the hypothesis that *corporeal reactions to works of art possibly are more similar and interhuman understandable than culturally coded reactions*. As the arenas of exhibition and research appears culturally fairly homogenous, despite an international participation and audience, this remains to be confirmed. However, all indications from my material and observations point to this. Then again, this could be because there are no cultural references or background to judge from. The history of haptic art is too short for this.

Through its psychophysical design (chapter three), the Erotogod installation, phenomenologically speaking, makes itself present-at-hand through its potential both to incite breakdown of expectation and haptic sensations. One consequence is that anticipations are more likely to be ‘reset’ and that recipients open themselves to new reflections and experiences because they do not know what occurs. This is another conclusion derived from user observation in my Erotogod installation (chapter seven).

From a phenomenological point of view, the bodysuits represent an interesting intervention. They create a layer, that is a distance between the subject and the experience. Through this estrangement the body can experience for itself. The effect is a phenomenological experience of corporeal autonomy. As my projects indicate, this can artistically be used to provoke sensations indirectly, such as pleasure.

8.2.5. Methodological contributions towards practice-based research in the arts

The methodologies discussed in chapter two outline a sound practice-based orientation towards research in the arts. This must be seen in combination with a systematic and methodical knowledge production relevant to the arts that occur throughout the thesis.

The phenomenological approach has been inspirational to my work. Justification for this advancement has been my strong experience of the anthropomorphic and therefore embodied nature of the arts.

My intention has not been to establish a new and ‘authoritarian’ methodology for others to follow, but to develop a functional method for practice-based research that lets both artists i) create works and ii) feed back into what ideally appears as a critically-informed practice.

My efforts have aimed at giving contributions to practice-based research and can be summarized as:

- A functional approach to observing and analysing interactive art installations.
- An inspirational toolbox for practice-based research through my mapping of scientific approaches relevant to artistic research.
- A contribution to the opening up of the artistic domain as a scientifically sound epistemological field where new knowledge can be found and formalized.
- A useful application of break down situations as a method of measurement.

8.2.6. Applications of this work

There are several possible applications of this work. It touches upon and is related to the various areas such as the design of:

- Immersive environments, to the extent that it offers a practical approach to the construction of haptic technologies that has a proven effect on users’ sensation of immersion.
- Interface design, as far as it describes the various psychophysical approaches
- Haptics in that the research is specifically targeting development of vibrotactile stimuli.
- Ergonomics, by how the research presents bodysuits as a highly functional way of designing and applying haptic expressions and communication.

The thesis also has implications for how we understand the material components of art making. It approaches the area of artistic production not only as a field of physical and material production, but expands it through inclusion of perceptual manipulation as an additional artistic tool. This is demonstrated in the various psychophysical elaborations.

The whole thesis presents the arts as a valuable field for research. From chapter one onwards the various issues that makes artistic research such a unique research practice are presented. It also shows how the arts contribute to building knowledges. Which parts of artistic practice generate knowledge was framed and discussed on methodology in chapter four. Applications of this approach are to open up the field further and stimulate future research.

Currently digital technologies are based upon interfaces reading the body. This one way contact is not enough. Letting users actively feel the world – both the physical and the virtual - will enhance the combination of the user with his technological tools. The scenario of multisensory, audio-corporeal connectivity is partly experimental science¹¹⁶, partly a future vision played out in artistic contexts. Examples of this is both the Erotogod project, but also project groups like *Blast Theory* which won the Golden Nica of interactive art in 2003 for their multidimensional, multisensorial and participatory theatre projects. To investigate the immense possibilities of digital media, it is necessary to identify and label dimensions of perceptual experience in multisensory environments.

In my work I have employed qualitative methods to model and predict users' emotional responses. At its core is the active participation of the researcher in a research process where changes are actively induced.

By active user observation, video analysis, questionnaires and interviews I found the users to actively engage in the self-reflective communicative process represented by the installations sensory loop. Their experience was one of surprise, physical enjoyment and engagement. Direct perceptual breakdowns were not directly observed in participant observation, but reports on such experiences appeared in the answers to the questionnaires.

8.3. AIMS AND OBJECTIVES ACHIEVED

The aims of the research reported in this thesis have been several. The aims have all been approached, and in some cases achieved, through practice. The objectives of the research have in general been to map dimensions of touch in relation to multimodal expressions and so contribute new knowledge to the field. Following the analysis in chapter seven and the answering of the research question above, the aims and objectives achieved in this thesis can be listed as:

¹¹⁶ As remote telehaptic research for controlling space stations.

- Aim and objective 1 was to test the existence of perceptual symbiosis through participatory observation and visual analysis of the users of my projects. An understanding of cross-modal combinations based on touch has thus been developed. This has been achieved through the methodology developed in chapter two and the practice-based experiment *Erotogod* in chapter six.
- Aim and objective 2 was to test of sensory resolution through different haptic body interfaces with varying degrees of tactile resolution. My objective with this is to develop better bodysuit designs. My aim has been partially fulfilled. In my art practice I have developed several bodysuits in parallel to the writing of this thesis (*Inter_Skin II*, *World Ripple* and *The Blind Theatre* (2009)), but as there is little data collected these will not be taken into consideration here. They have, however, helped realize my objective of developing better bodysuit designs both mechanically, and in terms of the relevant hardware and software.
- Aim and objective 3 was first to investigate the ‘real virtual sensation’ through the construction a multimodal interactive installations like *Erotogod* and see if and how user experience changes with varying degrees of sensory experience. The aim has been realized, and the objective to develop improved ways of telling haptic stories follows from the research completed.
- Aim and objective 4 was to test the existence of a haptic vocabulary through development of a general technique that can be used in other contexts and projects, thereby developing a clear haptic vocabulary and theoretically understanding of the phenomenological dimension of touch. This has been partially achieved through the discussions in chapter four and the practical work documented in chapter six. However, the development of a clear and extensive haptic vocabulary has proved a practical task beyond the scope of this thesis. Nevertheless, the practical and theoretical discussions throughout the thesis have fulfilled the second objective of developing a better theoretical understanding of the phenomenological dimension of touch.

The scope of the research is appropriate to art and design practice. Such research is time- and resource consuming. It takes a long time to plan and realize practical developments with computer-based technologies. Projects on the scale of *Erotogod* also involve more people in the development. Consequently other issues like group psychology, economy and cultural

differences (in the case of international teams) become important to how fast one can expect progress.

Finally, it was an aim and objective to investigate the use of interactive media in order to develop further working practice and guidelines for interface development. This is achieved through the discussions in the various chapters and in chapter six in particular.

8.4. CONTRIBUTIONS TO KNOWLEDGE

Throughout my own research I have been inspired by reading other artists' work on art and research. This is very much a field in the making, and it is my hope that this thesis contributes as a building block to subsequently integrate artistic research into a legitimate research structure. As a result of my research and when applying its findings to similar projects, it has been my ambition that others will be able to:

- Further clarify what is meant by 'touch'.
- Gain insight into the significance as well as complexity of multisensory applications.
- Give reasons why the use of touch is valuable in making multisensory environments.
- Use touch when planning and creating such environments.
- Have a view as to whether the use of touch better enables applications to present and express the intention of the touch artist/designer.
- Use interactive media to generate insight and catalysis in the working practice of artists and designers.
- Understand the value of haptics in creating immersive media processes.

Showing and sharing experiences is also part of building new knowledge. The output of the research as artwork was shown during three exhibitions: first at the Henie Onstad Art Centre in Norway in 2001, then at DEAF exhibition in Rotterdam in 2003 and finally at Atelier Nord in Oslo also in 2003. Altogether the total number of participants that experienced the installation haptically from the inside is between two and three hundred. In addition to this comes the several hundred that visited all exhibitions, but could not take part due to the limitations in capacity that one bodysuit imposes.

8.5. STRENGTHS AND LIMITATIONS OF THE THESIS

The strength of the thesis lies in its multi-method investigations and its application of hybrid methodology. It is also rooted in the phenomenological tradition that emphasizes embodied interaction. The research has pointed towards the significance of embodied interactions in experimental system designs like Erotogod. Another point adding to the strengthening of the methodology is the diversity of roles adopted by the researcher. These are all advantages of the research.

On the other side the limitations are several. The approach of the researcher can appear biased as the main example, the Erotogod installation, is based on a personal, artistic practice. It is a challenge to openly and intersubjectively evaluate one's own work. Methodologically, the thesis tends towards an overreliance on a qualitative approach. Other and more quantitative methods and data are needed to correct for the many uncertainties reflected in the analysis. Theoretically there might be an overemphasis on phenomenology where other models and views of for example the HCI sector and somaesthetics also could be appropriate. However, even with these limitations the findings here are relevant and significant at large.

At the outset of the thesis, one of my aims was to produce better art through research. To the question if this is possible, my answer is both yes and no. Depending on what is the aim of the artistic production, formal research can give a lot of inspiration that might lead to new practical projects. It can also consume time and energy from the often irrational inspirations that lead to artistic practice. Whereas I consider Erotogod to be an art project, I consider this thesis to be an elaboration of it that promotes insight and knowledge about art works. However, this thesis has neither attempted to be, nor is it an artwork in itself. Most importantly this thesis has contributed iteratively to the development of my critically-informed practice and research (Kemmis and McTaggart, 1988:11-14).

8.6. FUTURE DEVELOPMENT

Engineering the Erotogod project gave me an interest in applying its technology in a telepresence project with two users as was done with cyberSM (1993) and inter_skin (1994). This resulted in the 'Inter_skin two' project that was shown at Gallery Nova in Zagreb in 2004. For this project I built two intelligent bodysuits based on the technology developed for Erotogod. Each suit had 120 input and outputs and was designed as a grid like pattern of dual effector/sensor zones. I put much emphasis on the practical design of the suits and the system functioned very well on a technological level. However I was not satisfied with the artistic appearance

as the reception of the work is dependent on the contextual coding, in this case the development of a dramaturgical story and component. One of the aspects that is interesting to elaborate in future projects is how the synaesthetic experience is modelled by symbolic and aesthetic features.

This was partially done in the GPS-based World Ripple project described in chapter six. One of the performances was in Teheran and users were dressed in a bodysuit modelled as a typical Iranian chador for women. That gave both a strong psychophysical coding and a symbolically charged context. The World Ripple technology was further developed into an indoors theatre for the blind and blindfolded. This was performed at the Norwegian National Theatre in September 2009. Here great care was given to design all haptic elements, from suit, touch, and sound to contextual framing (the chosen areas in the darkened theatre) as well as how users were directed by a personal guide. A combined version based on the approaches found in the blind theatre and the World Ripple project is planned to be performed at the roof of the new Opera in Oslo in 2010/11.

8.7. RECOMMENDATIONS FOR FUTURE RESEARCH AND WORK

Haptic stimulation in general and vibrotactile stimuli in particular opens up a whole new dimension for the development of both instrumental applications and artistic experiments within the digital domain.

From a technological point of view there is a great demand in improving tracking technologies like GPS to facilitate embodied interaction in the real world. A user's position can reveal details about his/her activity, needs and intentions. Geo-logging and -tagging user's movements in real time opens up real-time environmental haptics. From an engineering point of view it is, for example, possible to contribute to the construction of better functional vibrotactile 'seeing' apparatus for the blind. A sensory-visual resolution well below one meter (outdoors) should be possible.

Technologically speaking, current effectors are clumsy and mechanical. Only vibrotactile effectors prove effective. It would represent a significant qualitative leap if one could develop miniaturized effectors based on temperature and other (e.g. pneumatic) ways of creating sensations of pressure as well. Increasing the numbers of effectors while minimizing their size presents another challenge.

Several social issues remain open. The section on corporeal affordance in chapter four shows that multiuser systems including haptic stimuli must take social systems and cooperative strategies into consideration for successful design to develop. This is a new area that calls for additional research. How for instance is touch perceived in the context of a simultaneous, multiuser context like Facebook; or a (future) haptic Twitter? What can the

combination of high tactile fidelity and ordinary, Facebook-like activities result in?

One thing is how we sense touch, another is how we represent it outwards. Bodysuits are both a technology affecting the user's inwardly-oriented perception as well as signalling outwards what happens. The design of bodysuits is therefore faced with at least a twofold challenge. One is to develop a better ergonomic functionality. The other is to experiment with looks in the context of fashion. In relation to transparent media, how does one design a practical bodysuit, wearable close to the skin for longer periods and integrated into normal clothing? This underlines the need for more research.

In relation to the psychophysical representation and perception of sound through Erotogod's 16' channel sound sphere (chapter six), an interesting question is what would have changed with i) more loudspeakers (24 or 32), ii) fewer, for example 8, or even iii) through binaural rendering listened to via headphones.

The end of chapter two posed the question whether there are similar ways of constructing knowledge systems within both art and science. In line with an autoethnographic approach I have consequently tried to explore, describe and explain Virtual Touch in an open and unbiased way. A consequent methodology shows that the combination of art and media – as in this thesis – leads to the discovery of new knowledge and establishment of new strands of research. This approach is like a scout running ahead to explore and get a first overview of the ground, a necessary move to prepare for further and exact action. The artistic knowledge gained is a result of experimental phenomenology and complements that of the hard sciences.

New in this thesis and approach are therefore i) the combinations of the various theories on and about touch, ii) the application of this on my own artworks, and iii) the contribution to the definition of new practices of inquiry and knowledge making.

In thematizing art as a making discipline, this thesis contributes substantially to knowledge generation about the multimodality of touch within the art field, and hopefully it also opens up unexplored avenues of research - how we perceive and produce art.

9. APPENDICES

9.1. BIBLIOGRAPHY

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9.3. NOTES ON THE PRODUCTION OF EROTOGOD

Inside the Erotogod installation it is the installation as a product that counts. However, in the context of artistic research and the ethical issue of taking both other researchers and historical developments in the field into account, yet another important factor behind all complex works of art is their history of production. This history can highlight several issues of why and how an artwork becomes its form and expression. The Erotogod project was initiated by me, but the practical realization was very much the work of a group of individuals. Producing an installation with the size, budget and technical complexity of Erotogod is only possible with a team of specialists. In addition to me the main contributors to the installation was Knut Mork Skagen, Asbjørn Flø and Trond Lossius. Knut M. Skagen had the central role of developing the graphics and the coding of the both the graphical and installation-control software. He also participated in developing the concept. The soundsoftware and composition was done by Asbjørn Flø and Trond Lossius. Other assistants and co-workers were Einar Øverenget who helped develop the initial concept, Siv Thorud who designed the bodysuit, dd who programmed most of the touch patterns in the bodysuit, Max Rheiner who wrote the LUA script and server for the suit-interface and Thomas Jøndal who built the suit-interface

How does such collaboration influence the artistic output? I think it does to a great deal, and I have experienced that the artistic expression can both be hindered, but also possibly strengthened. The success of working in a group is to a large degree a question of group dynamics. It is not only a question of having the most competent people to work towards a common goal, but also to have them function as a team. My experience is that this is a real challenge, but that the success of a project is directly linked with the success of the social group dynamics. The group must work well together. One way is achieve this is to make the group meet socially outside the work zone, share work experience, bond over beer and talk about other socially interesting things. This makes up for the social glue in such projects, which is very important since the deadline-oriented, high intensive work has a tendency of wearing out the members of the group. Afterwards most people feel exhausted, mentally drained and fed up with each other.

Erotogod was a successful project both on a technical and artistic level. However, I have never been completely satisfied with its artistic result. Especially the sound became too technical and 'clean' compared to the energetic and spatially swirling experience that originally was imagined. This discrepancy was both due to the difference in artistic temper and taste between the interactive music composers on the one side and me on the other, but also due to the short development time.

9.3.1. Financial issues

Financial support is at the root of any art production. To create and get the needed funding the preproduction and planning phase of Erotogod lasted almost two years before the first show at Henie Onstad in 2001. The partners that financially supported and practically made the project possible are:

- Telenor Research and Development
- The Norwegian Council for Cultural Affairs
- Ultima – Oslo Contemporary Music Festival
- The Norwegian Traveling Exhibitions – now a part of the Norwegian National Museum
- Henie Onstad Art Centre
- NoTAM – www.notam.uio.no
- Bergen Center for Electronic Art (BEK)

Listing these partners is important to illustrate some of the other workload and effort that lies behind producing an electronic and interactive art installation. Such partnerships are important and necessary. Simply keeping in contact with them demands a certain form of marketing and communication skills. This again is relevant for the social complexity of art. An interactive artwork like Erotogod is not just one-mans work made for the mass-audience, but its realization is also dependent on the collaborative effort of both many people and many institutions.

Design of the different sound, touch and visual elements was at first done separately. The joining of the different expressions was done based on previous experience and discussion. All components were first tried together during the first version of the installation when shown in 2001. This was primarily due to the complexity of all the components that made complete testing unpractical and too expensive. One example of this is the price of hiring a 16 channel professional sound equipment that we did for Henie Onstad Art Centre in 2001. It cost over a third of our exhibition budget. Also we did not have the space to mount such a large system.

9.4. THE MILLENIUM RELIGIONS

Through a technologically mediated sensuality EROTOGOD elaborates on the convergence of the world religions - that have the same offspring. The installation works as a sensual synthesizer. It manifests itself through the dynamic restructuring of central texts taken from divine manuscripts. EROTOGOD has as its departing place in central texts from The Old Testament, The New Testament and The Koran. Judaism, Christianity and Islam are all religions where the idea of the Millennium is central. They all have concepts of the end of time as well as apocalyptic texts concerning this. An important foundational idea is that one Time period ends and is replaced by a new epoch. This belief represents the foundation for understanding and coping with contemporary evil and injustice. The concept of the Apocalypse (Endzeit) sees both the sensual and technological dimensions as expressions of decadence that announce the coming of a new Epoch. Now at the beginning of a new Millennium the project establish a new meeting place between these Millenniumistic religions. Through technology they merge sensuously.

9.5 HAPTIC LINKS AND REFERENCES

- Steim, Center for research & development of instruments & tools for performers in the electronic performance arts. Laboratory, workshop, international meeting place, etc . [<http://www.steim.nl>]
 - Anthony Dunne and Fiona Ruby various technological and haptic designs: <http://www.dunneandraby.co.uk/>
 - Iain Mott, haptic interfaces for the production of sound, <http://www.reverberant.com/>
 - Stephen Wilson overview and linkpage of the Intersections of Art, Technology, Science & Culture <http://userwww.sfsu.edu/~infoarts/links/wilson.artlinks2.html>
 - ComTouch, vibrotactile mobilephones <http://tangible.media.mit.edu/projects/comtouch/>
 - <http://www.cultsock.ndirect.co.uk/MUHome/cshtml/introductory/sw.htm>
- 1
- The Museum of Pure Form, www.pureform.org , The Museum of Pure Form is a virtual museum of digital art exploring new paradigms of interaction with digitized sculpture, new media, and architectural space. In the museum's Virtual Gallery, visitors can use innovative technologies allowing them to interact with 3D art forms and explore the museum with stereo vision, perceive tactile stimuli, and feel physical contact with virtual works of art.
 - Blog on haptics: http://blogs.warwick.ac.uk/crpl_art/tag/haptic/

9.6 BASIC TOUCH PATTERNS AND TOUCH SCRIPTS IN EROTOGOD

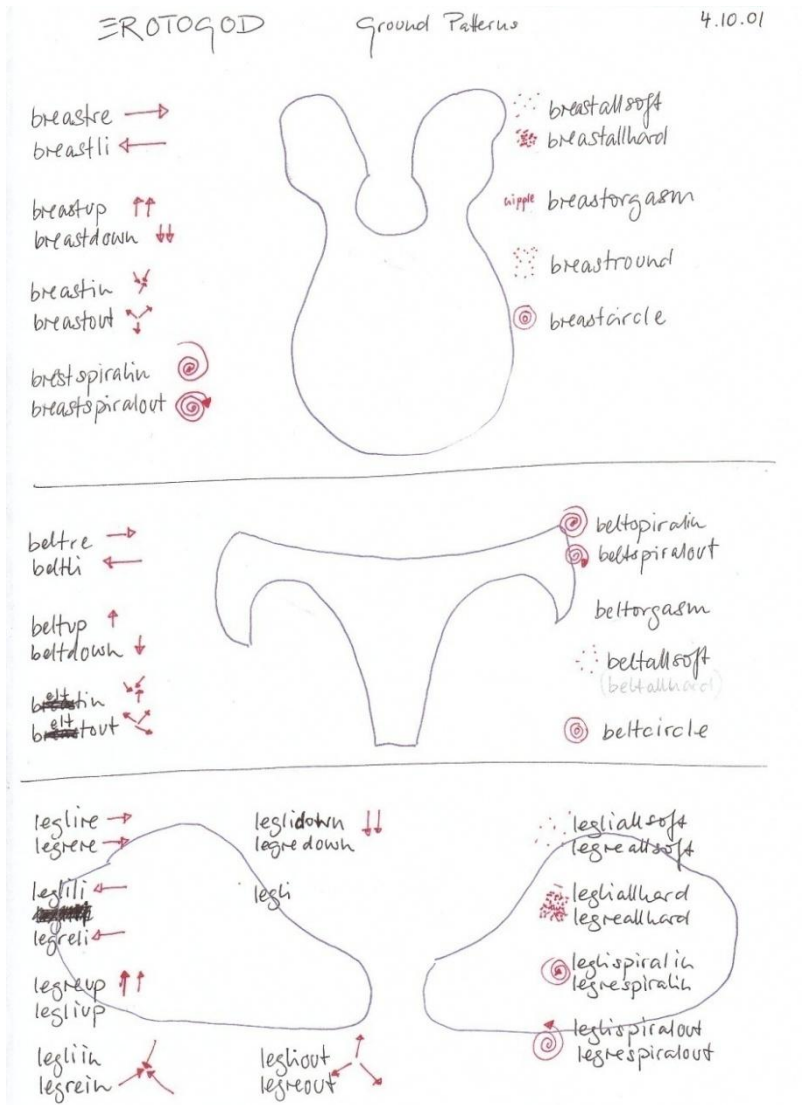


Figure 9-1 Shows the basic patterns assigned to the various parts of the Erotogod bodysuit.

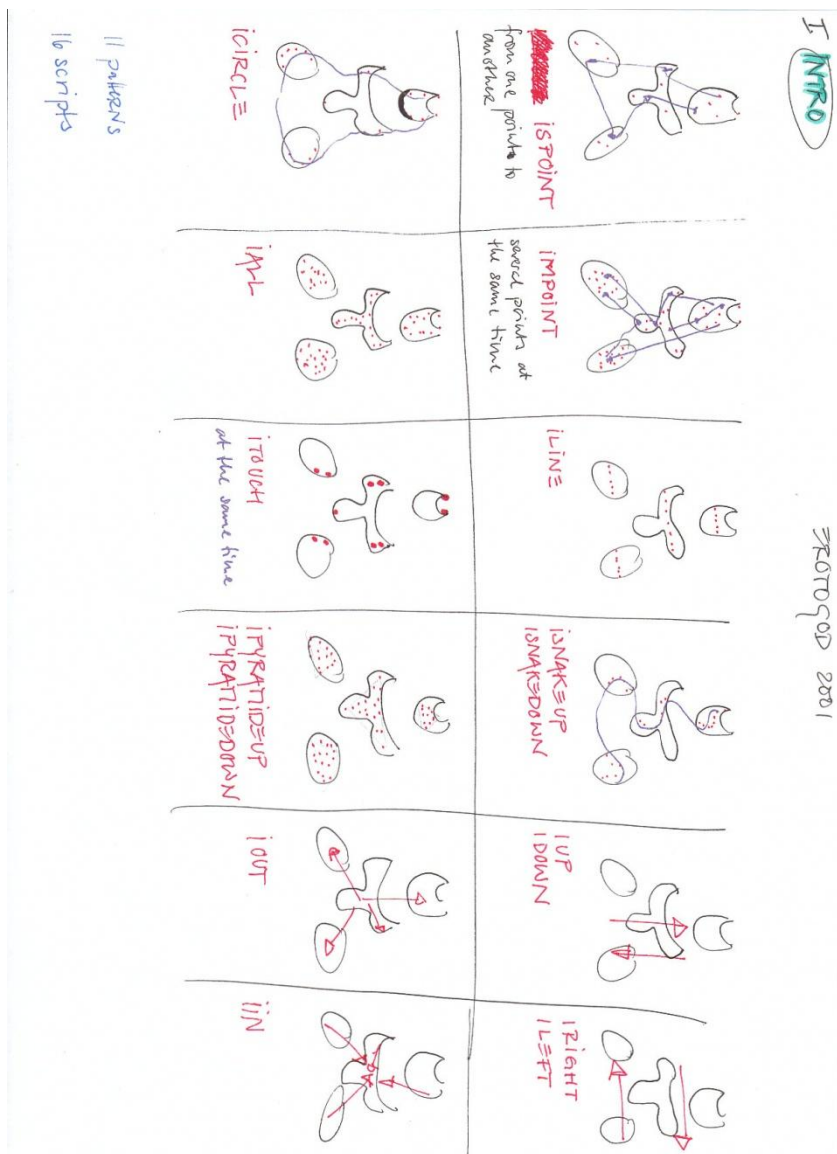


Figure 9-2 Schematics of Erotogod I introductory and basic touch patterns.

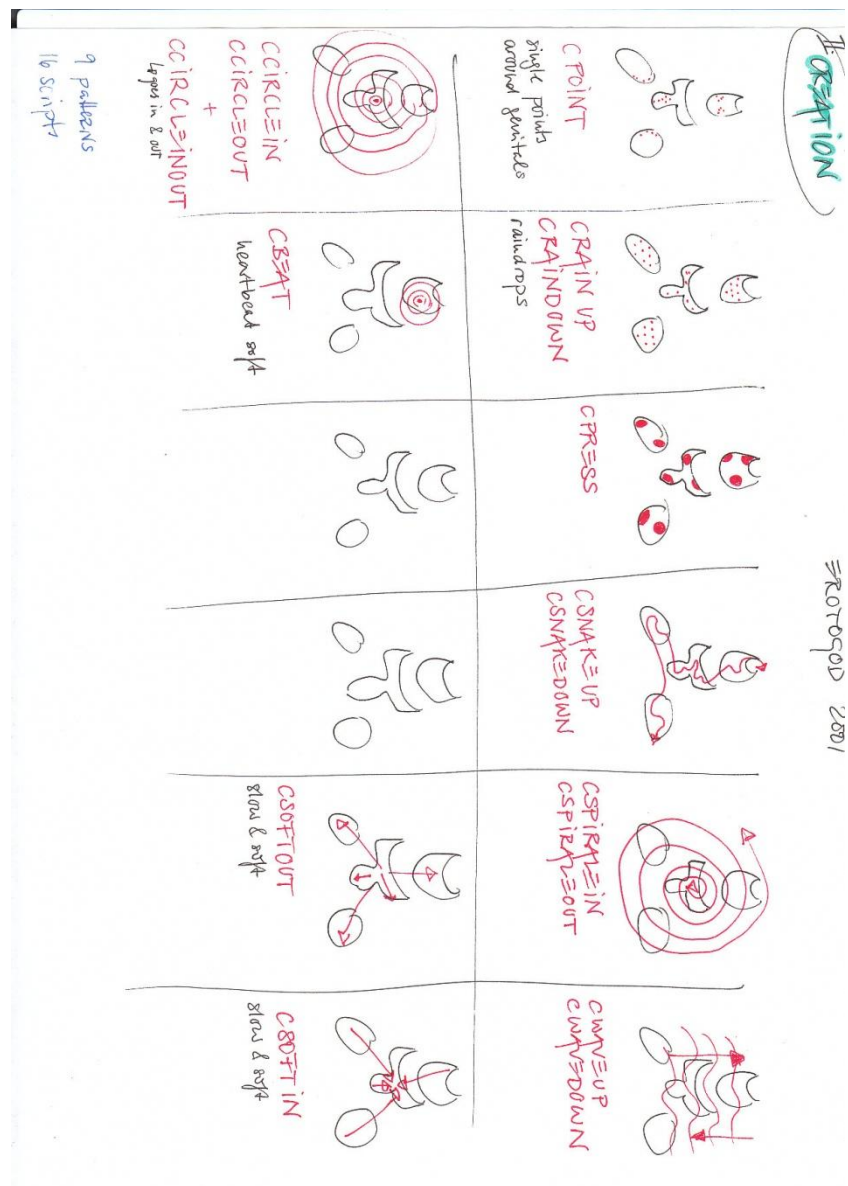


Figure 9-3 Schematics of Erotogod II basic touch patterns.

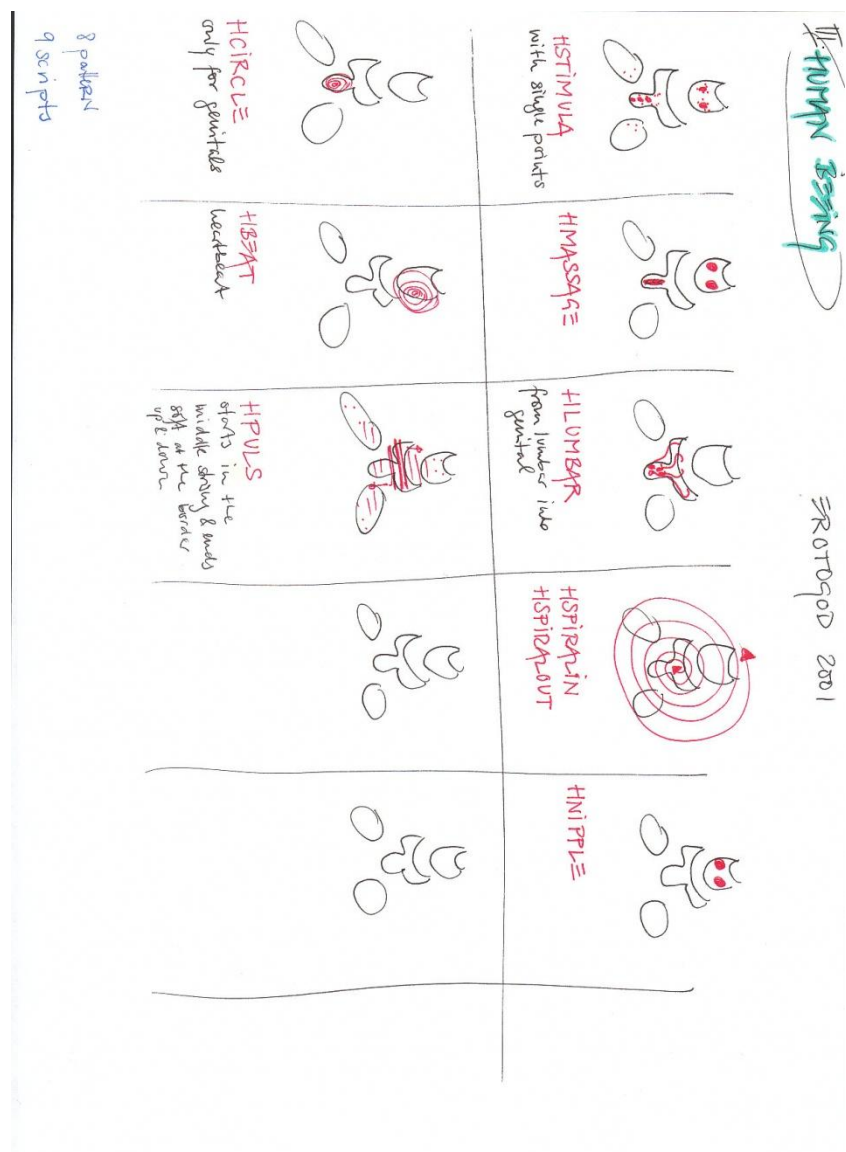


Figure 9-4 Schematics of Erotogod III basic touch patterns.

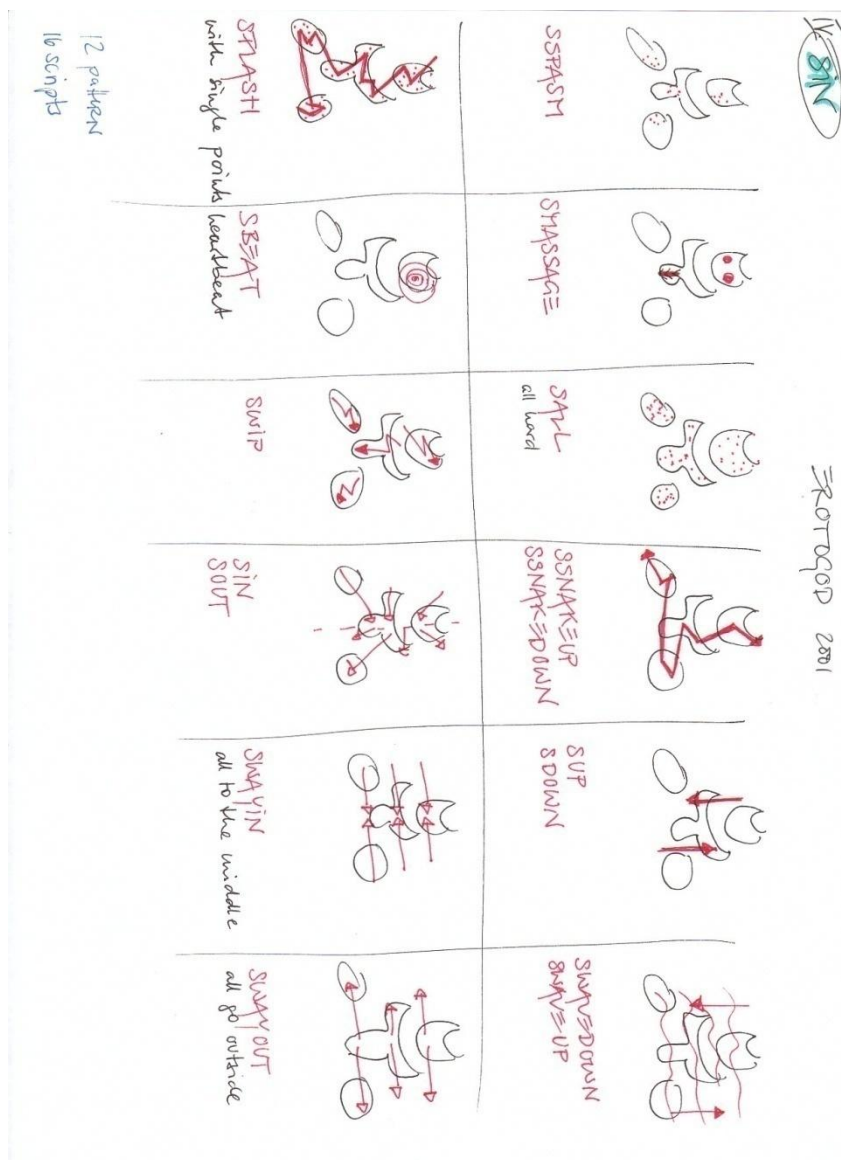


Figure 9-5 Schematics of Erotogod IV basic touch patterns.

9.7 PLACEMENT OF SENSORS AND EFFECTORS IN EROTOGOD BODYSUIT

MOTORSKJEMA erotogod

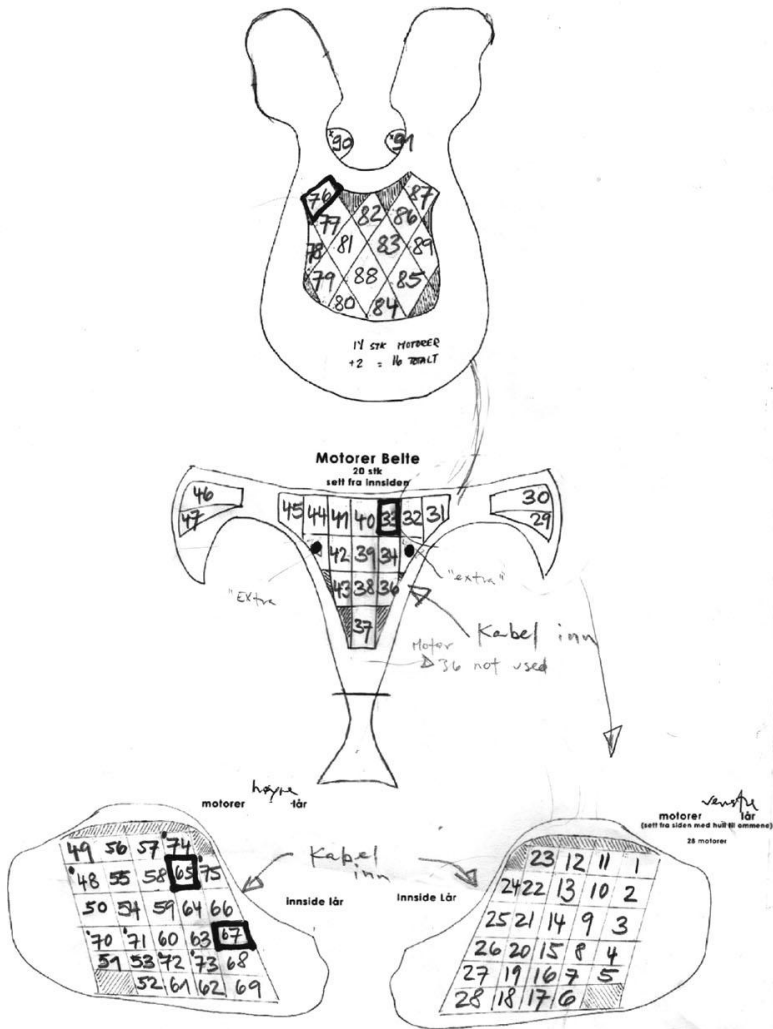


Figure 9-6 Placement of the vibrotactile, custom made effectors (output).

BRYTER SKJEMA erotogod

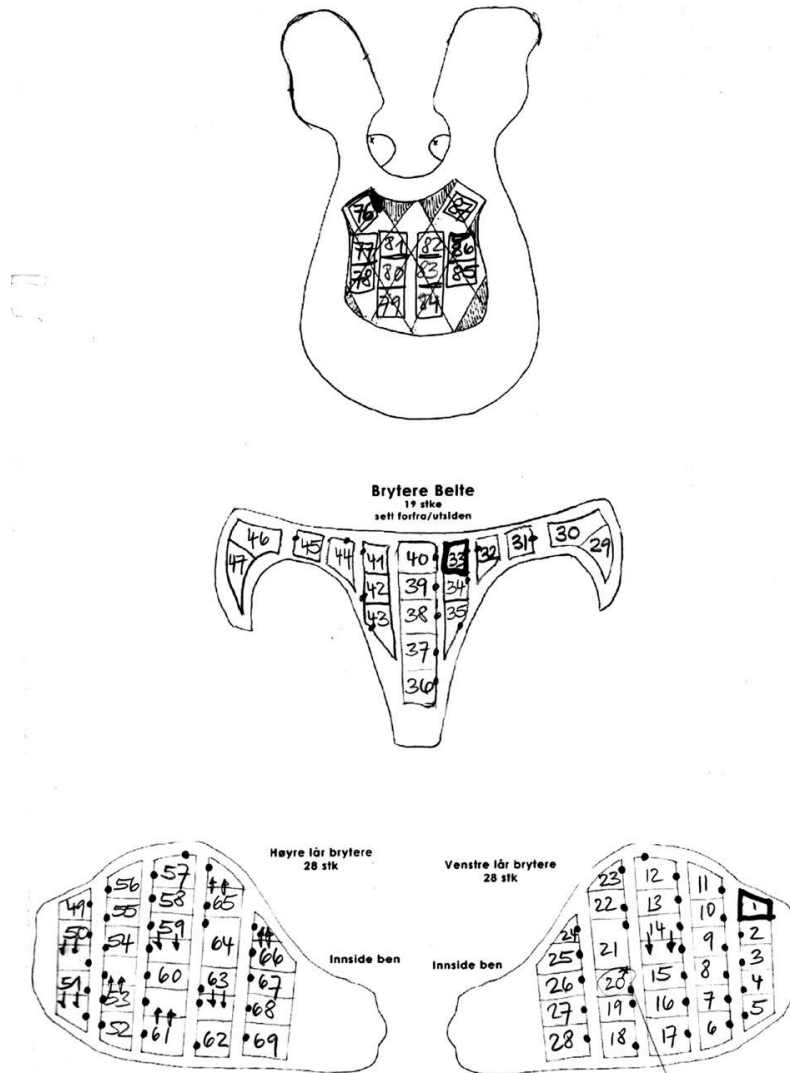


Figure 9-7 Placement of the digital sensors (input).

9.8 REVIEW OF EROTOGOD AT THE DEAF FESTIVAL

The following is an online review of the Erotogod installation at the DEAF festival in Rotterdam 2003: **Rotterdam: new media pleasure & pain.**

By Anna Davis, from <http://www.realtimearts.net/article/issue54/7060> accessed on March 10th 2010

Deciding I needed some bodily stimulation I headed for Stahl Stenslie's (Norway) Erotogod which was standing tall in the darkness like some futuristic altar to the god of technology. An imposing steel structure, it looked like a chrome wave with an inverted pyramid made of white latex projection screens on its peak. The work was constantly surrounded by hordes of eager visitors. I watched as each person was led up the Erotogod ramp by an attendant and then asked to kneel and straddle a flexible metal paddle seat facing the 3 large screens. While the 'user' (who was looking more and more like the 'human sacrifice') was kneeling in this slightly humiliating position, the attendant fitted them with a glittering, padded 'suit' that looked scarily like a reject costume from an 80s Andrew Lloyd Webber musical. The 'victim/user' was left on the altar while texts and images were generated on the 3 semi-opaque screens and deep vibrating sounds emanated from 16 speakers placed around the work.

Although initially put off by the 80s spacesuit, I decided to tackle the Erotogod myself. As the suit was fastened between my legs and around my chest and arms the attendant explained that it was full of many sensors and that I should touch myself to trigger different images, sounds and texts from The Koran, The Talmud and The Bible. As I was left alone and feeling quite silly, a new aspect of the work quickly became obvious to me. By touching yourself through the suit, waves of different vibrations emanated through the suit and into your body. I was so distracted by these intense vibrations I hardly noticed the scripts from the sacred texts that were appearing around me. After what was a pleasantly exhilarating, multi-sensory 5 minutes, I left the work looking slightly flushed. Erotogod says Stenslie, 'is a futuristic media altar linking auto-erotic touching to stories of Creation; a sensory fusing of religions.' Quite a sensation from one of the early founders of Cybersex (Stenslie built a full-body, tele-tactile communication system in 1993).

DEAF03, Dutch Electronic Art Festival. Data Knitting, organised by V2-Institute for the Unstable Media, Rotterdam, The Netherlands, Feb 25-Mar 9

Anna Davis is a new media artist, part-time writer, curator and project coordinator. Her visit to DEAF03 was supported by a RUN_WAY grant from the New Media Arts Board of the Australia Council.

9.9 THE EROTOGOD QUESTIONNAIRE

Below is the questionnaire as it was used during Erotogod at the DEAF festival in Rotterdam in 2003. Those interviewed were asked to circle around their answer:

1: SEX: Male Female

2: Age: 0-15 16-24 25-30 31-40 41-50 51-60 61+

3: Education / occupation:

.....

4: How often do you go to art exhibitions?

weekly every month every 6. month once a year never

5: Have you tried similar installations before? YES NO

If YES, which ones?:

.....

.....

.....

In the following questions, please place a check mark at the point on the scale that best represents your judgement:

6: The installation is:

challenging	—	—	—	—	—	—	—	simple
static	—	—	—	—	—	—	—	dynamic
boring	—	—	—	—	—	—	—	exciting
pleasant	—	—	—	—	—	—	—	unpleasant
dreamlike	—	—	—	—	—	—	—	real
meaningful	—	—	—	—	—	—	—	pointless

7: The sound was:

quiet	—	—	—	—	—	—	loud
chaotic	—	—	—	—	—	—	harmonic
light	—	—	—	—	—	—	dark
static	—	—	—	—	—	—	dynamic

8: The bodysuit was

good	_ _ _ _ _	bad
human	_ _ _ _ _	mechanical
uncontrollable	_ _ _ _ _	controllable
exciting	_ _ _ _ _	boring

9: The projections were

harmonic	_ _ _ _ _	chaotic
meaningful	_ _ _ _ _	without meaning
unreadable	_ _ _ _ _	readable
static	_ _ _ _ _	dynamic

10: How did you master the installation?

full control	_ _ _ _ _	no control
--------------	-----------	------------

11: My experience of the installation was

fascinating	_ _ _ _ _	ordinary
erotic	_ _ _ _ _	mechanized
dull	_ _ _ _ _	interesting
interactive	_ _ _ _ _	static

12: To what extent did you control the sound?

a lot	_ _ _ _ _	not at all
-------	-----------	------------

13: The sound made my experience

very complete	_ _ _ _ _	very fragmented
---------------	-----------	-----------------

14: The bodysuit influenced me

very much	_ _ _ _ _	not at all
positively	_ _ _ _ _	negatively

15: Could you influence the projections?

a lot _ _ _ _ _ not at all

16: Did you feel in control of what happened to you inside the installation?

No control Little control Partial control Total control

17: What was easier or harder to control? Please describe:

.....
.....

18: To what degree could you control the installations technology?

No control Little control Partial control Total control

19. Please mark the words that best describe the feelings and experiences you had inside the installation:

Unpleasant Mechanical Good Erotic Sensual

Theatrical Pain Religious Emphatic Strange

Techno Nothing Embarrassing Wild Pleasant

Anything else?:

.....
.....
.....

20: Did you feel observed while inside the installation?

Absolutely not A little bit Notably Very much

21: If you felt you were observed, was that:

Unpleasant Annoying Without influence Exciting

22: Do you own one or more of the following technologies (circle all you use):

Cell phone PDA Walkman/Diskman/MP3 (computer notebook)

23: How often do you use computers?

Never A few times Once or twice Once or twice Every Day
a year a month a week

24: If you use computers, which Operation System (OS) do you use?

Apple Mac Windows Linux

25: If you use computers, which software do you mostly use?

(Mark ALL you use)

Image processing Word-processing Sound Web/Internet

26: Does the installation have anything in common with today's computers?

YES

NO

Please explain why / why not:

.....
.....

27: In the future, current interface technologies like the mouse and keyboard will most likely disappear. Do you think that future computers will –somehow- be like Erotogod?

YES

NO

28: The Installation uses three-dimensional sound, graphics and an interactive bodysuit. Could you imagine using the installation to do some kind of work?

YES

NO

If you answered YES, which kind of work:

.....

If you answered NO, why not?:

.....

29: Do you have a religious conviction YES NO

If YES, which one?

.....

30: How many minutes were you inside the installation?

3

5

7

10

15

20 +

31: Would you like to try the installation again? YES NO

Why / Why not?

.....

32: Do you have any other comments to the installation?

.....

9.10 FREQUENCY TABLE FOR THE QUESTIONNAIRE

Q1 SEX 1=Male 2=Female

Code	Value	Frequency	Percent
	1 male	21	57 %
	2 female	16	43 %
	Total	37	100 %

Q2 Age

Code	Value	Frequency	Percent
	10-15	0	0 %
	2 16-24	11	30 %
	3 25-30	15	41 %
	4 31-40	7	19 %
	5 41-50	3	8 %
	6 51-60	1	3 %
	7 61+	0	0 %
	Total	37	100 %

Q3 Edu Occupation

Code	Value	Frequency	Percent
	1		
	2		
	Total		

Q4 How ofte U visit exhibitions?

Code	Value	Frequency	Percent
	1 weekly	2	5 %
	2 every month	24	65 %
	3 ev 6 month	9	24 %
	4 once a year	2	5 %
	5 never	0	0 %
	Total	37	100 %

Q5 Tried similar installations?

Code	Value	Frequency	Percent
	1 yes	10	27 %
	2 no	26	70 %
	Total	36	97 %

Q6i The installation is:

Code	Value	Frequency	Percent
	1 challenging	6	16 %
	2	13	35 %
	3	5	14 %
	4	6	16 %
	5	2	5 %
	6	3	8 %
	7 simple	1	3 %
	Total	36	97 %

Q6ii

Code	Value	Frequency	Percent
	1 static	0	0 %
	2	0	0 %
	3	5	14 %
	4	1	3 %
	5	8	22 %
	6	14	38 %
	7 dynamic	8	22 %
	Total	36	97 %

Q6iii

Code	Value	Frequency	Percent
	1 boring	0	0 %
	2	0	0 %
	3	0	0 %
	4	1	3 %
	5	8	22 %
	6	15	41 %
	7 exciting	12	32 %
	Total	36	97 %

Q6iv

Code	Value	Frequency	Percent
	1 pleasant	13	35 %
	2	14	38 %
	3	5	14 %
	4	3	8 %
	5	0	0 %
	6	1	3 %
	7 unpleasant	0	0 %
	Total	36	97 %

Q6v

Code	Value	Frequency	Percent
	1 dreamlike	8	22 %
	2	12	32 %
	3	6	16 %
	4	8	22 %
	5	1	3 %
	6	0	0 %
	7 real	1	3 %
	Total	36	97 %

Q6vi

Code	Value	Frequency	Percent
	1 meaningful	3	8 %
	2	7	19 %
	3	12	32 %
	4	8	22 %
	5	5	14 %
	6	2	5 %
	7 pointless	0	0 %
	Total	37	100 %

Q7i The Sound was:

Code	Value	Frequency	Percent
1	Quiet	0	0 %
2		1	3 %
3		3	8 %
4		15	41 %
5		10	27 %
6		6	16 %
7	Loud	0	0 %
Total		35	95 %

Q7ii

Code	Value	Frequency	Percent
1	Chaotic	2	5 %
2		6	16 %
3		8	22 %
4		6	16 %
5		3	8 %
6		9	24 %
7	Harmonic	2	5 %
Total		36	97 %

Q7iii

Code	Value	Frequency	Percent
1	Light	1	3 %
2		3	8 %
3		4	11 %
4		9	24 %
5		10	27 %
6		7	19 %
7	Dark	2	5 %
Total		36	97 %

Q7iv

Code	Value	Frequency	Percent
1	Static	0	0 %
2		1	3 %
3		2	5 %
4		3	8 %
5		7	19 %
6		19	51 %
7	Dynamic	5	14 %
Total		37	100 %

Q8i The Bodysuit was:

Code	Value	Frequency	Percent
1	Good	13	35 %
2		14	38 %
3		6	16 %
4		2	5 %
5		1	3 %
6		0	0 %
7	Bad	0	0 %
Total		36	97 %

Q8ii

Code	Value	Frequency	Percent
1	Human	3	8 %
2		12	32 %
3		3	8 %
4		7	19 %
5		6	16 %
6		5	14 %
7	Mechanical	1	3 %
Total		37	100 %

Q8iii

Code	Value	Frequency	Percent
1	Uncontrollable	0	0 %
2		1	3 %
3		5	14 %
4		5	14 %
5		4	11 %
6		16	43 %
7	Controllable	5	14 %
Total		36	97 %

Q8iv

Code	Value	Frequency	Percent
1	Exciting	13	35 %
2		14	38 %
3		8	22 %
4		1	3 %
5		0	0 %
6		0	0 %
7	Boring	0	0 %
Total		36	97 %

Q9i The Projections were:

Code	Value	Frequency	Percent
1	harmonic	1	3 %
2		5	14 %
3		11	30 %
4		7	19 %
5		4	11 %
6		7	19 %
7	chaotic	1	3 %
Total		36	97 %

Q9ii The Projections were:

Code	Value	Frequency	Percent
1	Meaningful	1	3 %
2		5	14 %
3		13	35 %
4		4	11 %
5		7	19 %
6		5	14 %
7	Without mean	0	0 %
Total		35	95 %

Q9iii

Code	Value	Frequency	Percent
1	Unreadable	0	0 %
2		6	16 %
3		12	32 %
4		6	16 %
5		6	16 %
6		5	14 %
7	readable	0	0 %
Total		35	95 %

Q9iv

Code	Value	Frequency	Percent
1	Static	0	0 %
2		1	3 %
3		3	8 %
4		2	5 %
5		2	5 %
6		21	57 %
7	Dynamic	5	14 %
Total		34	92 %

Q10 Mastering installation

Code	Value	Frequency	Percent
1	Full Ctrl	2	
2		5	
3		13	
4		5	
5		8	
6		4	
7	No Ctrl	0	
Total		37	

Q11i My experience was

Code	Value	Frequency	Percent
1	Fascinating	13	35 %
2		14	38 %
3		5	14 %
4		2	5 %
5		2	5 %
6		0	0 %
7	Ordinary	0	0 %
Total		36	97 %

Q11ii

Code	Value	Frequency	Percent
1	Erotic	6	16 %
2		9	24 %
3		11	30 %
4		4	11 %
5		3	8 %
6		4	11 %
7	Mechanized	0	0 %
Total		37	100 %

Q11iii

Code	Value	Frequency	Percent
1	Dull	0	0 %
2		0	0 %
3		0	0 %
4		1	3 %
5		3	8 %
6		17	46 %
7	Interesting	15	41 %
Total		36	97 %

Q11iv

Code	Value	Frequency	Percent
1	Interactive	13	35 %
2		10	27 %
3		10	27 %
4		1	3 %
5		1	3 %
6		1	3 %
7	Static	0	0 %
Total		36	97 %

Q12 Controlling Sound

Code	Value	Frequency	Percent
	1 A lot	0	0 %
	2	11	30 %
	3	13	35 %
	4	4	11 %
	5	5	14 %
	6	3	8 %
	7 Not at all	1	3 %
	Total	37	100 %

Q13 Sound experience

Code	Value	Frequency	Percent
	1 Very Complet	3	8 %
	2	12	32 %
	3	13	35 %
	4	6	16 %
	5	1	3 %
	6	1	3 %
	7 very fragment	1	3 %
	Total	37	100 %

Q14i Bodsuit influenced me

Code	Value	Frequency	Percent
	1 very much	6	16 %
	2	10	27 %
	3	13	35 %
	4	5	14 %
	5	1	3 %
	6	1	3 %
	7 Not at all	0	0 %
	Total	36	97 %

Q14ii

Code	Value	Frequency	Percent
	1 Positively	13	35 %
	2	11	30 %
	3	8	22 %
	4	5	14 %
	5	0	0 %
	6	0	0 %
	7 Negatively	0	0 %
	Total	37	100 %

Q15 Influence projections?

Code	Value	Frequency	Percent
	1 A lot	1	3 %
	2	3	8 %
	3	17	46 %
	4	4	11 %
	5	6	16 %
	6	5	14 %
	7 Not at all	1	3 %
	Total	37	100 %

Q16 In control?

Code	Value	Frequency	Percent
	1 No	1	3 %
	2	9	24 %
	3	25	68 %
	4 Total Ctrl	2	5 %
	Total	37	100 %

Q17 What was easier to control?

Qualitatively question, written response

Q18 Control of tech?

Code	Value	Frequency	Percent
	1 no	1	3 %
	2	17	46 %
	3	18	49 %
	4 Total	1	3 %
	Total	37	100 %

Mark the words (several) describing

Q19 your feelings and experience

Code	Value	Frequency	Percent
	1 unpleasant	0	
	2 Mechanical	7	
	3 Good	12	
	4 Erotic	6	
	5 Sensual	26	
	6 Theatrical	15	
	7 Pain	0	
	8 Religious	1	
	9 Emphatic	4	
	10 Strange	20	
	11 Techno	8	
	12 Nothing	0	
	13 Embarrassing	3	
	14 Wild	1	
	15 Pleasant	24	
	Total	127	

Q20 Feel Observed? 1=no 4=total

Code	Value	Frequency	Percent
1	no	16	43 %
2		15	41 %
3		3	8 %
4	Total	3	8 %
	Total	37	100 %

Q21 If observed

Code	Value	Frequency	Percent
1	Unpleasant	6	16 %
2	Annoying	6	16 %
3	No influence	16	43 %
4	Exciting	1	3 %
	Total	29	78 %

Q22 Technologies you own

Code	Value	Frequency	Percent
1	Cell phone		
2	PDA		
3	MP3/walkman		
	Total		most have some

Q23 How often you use computers?

Code	Value	Frequency	Percent
1	Never	0	0 %
2	few times yea	0	0 %
3	once a month	0	0 %
4	every week	8	22 %
5	every day	29	78 %
	Total	37	100 %

Q24 Which OS?

Code	Value	Frequency	Percent
1	Mac	18	49 %
2	PC	27	73 %
3	Linux	1	3 %
	Total		

Note: several crossed both mac and pc
(deemed less relevant as most use computers almost daily)

Q25 Which software used?

Code	Value	Frequency	Percent
1	Image proc.		
2	word		
3	Sound		
4	Web internet		
	Total		

Note: Q25 appeared superfluous and its analysis is therefore not included.

Q26 Installation like todays computers?

Code	Value	Frequency	Percent
1	Yes	22	59 %
2	No	14	38 %
	Total	36	97 %

Q27 Future computers like Erotogod?

Code	Value	Frequency	Percent
1	Yes	25	68 %
2	No	12	32 %
	Total	37	100 %

Q28 Installation used for work?

Code	Value	Frequency	Percent
1	Yes	29	78 %
2	No	8	22 %
	Total	37	100 %

Q29 Religious conviction?

Code	Value	Frequency	Percent
1	Yes	8	22 %
2	No	29	78 %
	Total	37	

Q30 How many minutes inside installation?

Code	Value	Frequency	Percent
1	3 min	5	14 %
2	5 min	29	78 %
3	7 min	1	3 %
4	10 min	0	0 %
5	15 min	0	0 %
6	20+ min	0	0 %
	Total	35	95 %

Q31 Would like to try again?

Code	Value	Frequency	Percent
1	Yes	30	81 %
2	No	5	14 %
	Total	35	95 %